IMAGING DICOM GATEWAY
INSTALLATION GUIDE

Version 3.0

March 2002

Department of Veterans Affairs
System Design and Development
V*IST***A** Imaging

Preface

This guide is written to assist in the installation of the **V*IST*A** Imaging DICOM Gateway. The recommended background of those installing this software includes knowledge of workstations, Windows NT server and workstation software, and network component installation.

This guide also provides configuration specifications needed by the commercial DICOM vendors to properly interface their equipment to **V*IST*A**.

Revision History

9 March 2000	Original version checked in - Ed
1 August 2000	Many editing revisions – Pete and Ed
16 August 2000	More editing revisions – Pete
30 August 2000	Added reviewer comments from Amy Padgett – Pete
8 September 2000	Update names of accounts and groups to latest convention
20 September 2000	Incorporated final review ocomments from Dr. Ruth Dayhoff – Pete
21 March 2002	Final revision for Version 3.0

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BRIT	Brit Systems, Dallas, TX
Cemax-Icon	Cemax-Icon, a Kodak Company, Fremont, CA
CT/i	General Electric Medical Systems, Milwaukee, WI
DICOM	National Electrical Manufacturers Association, Rosslyn, VA
EasyVision	Philips Medical Systems, Shelton, CT
eMed	eMed Technologies Corporation, Lexington, MA
EndoWorks	Olympus America, Inc., Melville, NY
GEMS	General Electric Medical Systems, Milwaukee, WI
ImageShare	DeJarnette Research Systems, Towson, MD
Lumisys 75	Lumisys, Inc., Sunnyvale, CA
MediShare	DeJarnette Research Systems, Towson, MD
MSM	InterSystems, Corp., Cambridge, MA
OEC C-Arm	OEC Medical Systems, Inc., Salt Lake City, UT
PACS Broker	Mitra Imaging Inc., Waterloo, Ontario Canada
Siemens	Siemens, Iselin, NJ
V*IST*A	U.S. Department of Veterans Affairs
Windows NT, etc.	Microsoft Corporation, Redmont, WA

All patient and provider names, as well as all IP addresses used in example scripts are fictional.

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Chapter 1 Introduction

1.1 Overview

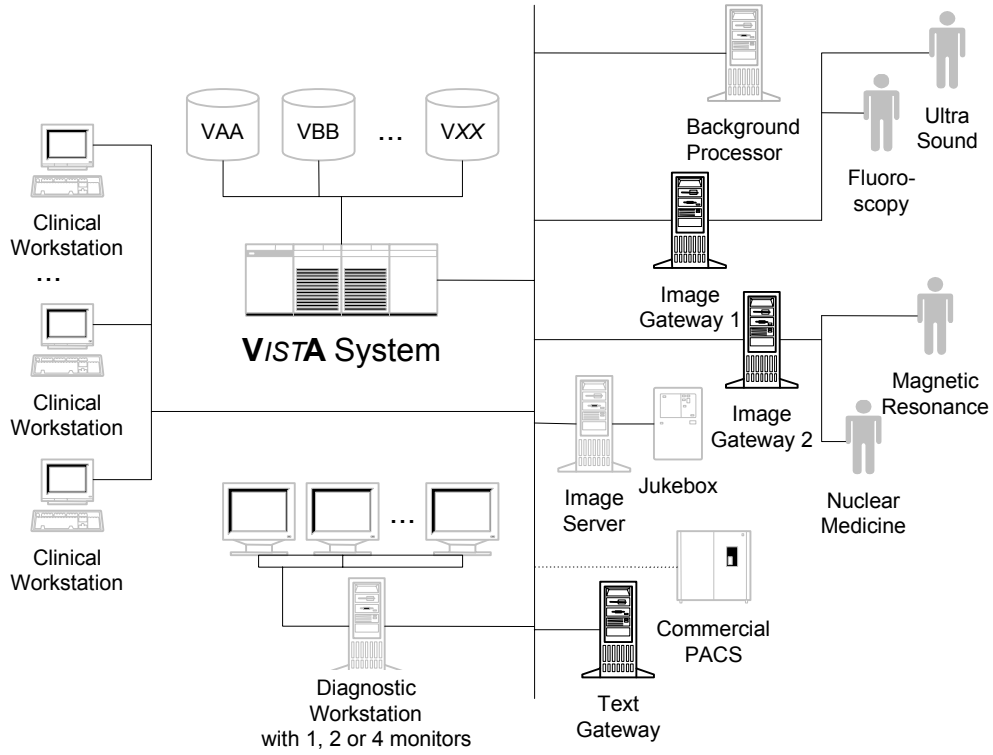
DICOM is the abbreviation for the **D**igital **I**maging and **CO**mmunications in **M**edicine standard. DICOM brings open systems technology to the medical imaging marketplace and enables **V***IST***A** to communicate directly with commercial medical imaging equipment.

DICOM is a set of networked client/server applications that are implemented on top of TCP/IP. DICOM is part of the **V***IST***A** networked application suite, along with CPRS, Kernel Broker, MS Exchange, and NT file servers. Similar networking techniques are used for installing and maintaining all of these applications.

The **V***IST***A** Imaging DICOM Gateway is written in MUMPS and runs on Microsoft NT Workstation, V. 4.0 or later. The interface uses the TCP/IP protocol to communicate with commercial DICOM devices and NT file servers, and the MUMPS DDP protocol to communicate with the **V***IST***A** hospital information system (HIS).

1.2 Typical configuration

The diagram below shows the most common configuration of a system in which the **V***IST***A** Imaging DICOM Gateway will be deployed.



The software described in this document should be installed on the DICOM Text and Image Gateways that are highlighted in **bold** in this diagram. Depending on the purpose of the system, several different installation options may be chosen.

In the diagram above, each highlighted processor has a dedicated function. It is possible to assign any combination of functions to any of these processors.

In theory, one processor could perform all tasks. In practice, however, it is much more efficient to assign specific tasks to specific processors. The typical configuration is one text gateway and one or more image gateways.

Based on considerations of needed screen real estate on displays and available licenses on a system, an Image Gateway should not serve more than three or four image acquisitions instruments (modalities).

1.3 Networking Topology Options

The The **V*IST*A** Imaging Project has a need for Ethernet capabilities in order to test equipment configurations that are being placed in the medical centers.

DICOM Gateways may use either one or two networking interfaces depending upon whether the commercial DICOM devices are connected directly to the main network backbone or are located on separate physical networks.

1.4 Commercial DICOM devices connected to Main Network Backbone

Some sites may choose to have all devices (workstations, main hospital computer, DICOM imaging producing equipment, etc.) connected to a single high-speed switched network backbone. In this case, the **V*IST*A** Imaging DICOM Gateway will have a single network connection to the backbone (see Figure 1.4).

Single High-Speed Switched Network

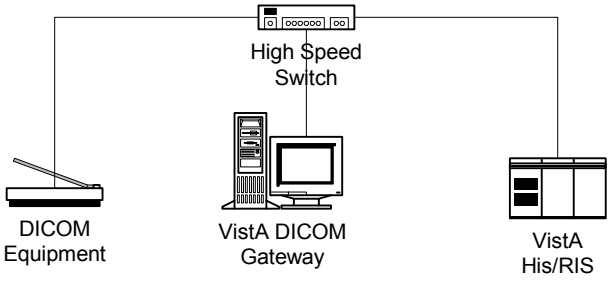


Figure 1.4

Note: The **V*IST*A** Imaging DICOM Gateway application relies on DDP, which is a non-routable protocol. So, if a router is used instead of a high-speed switch, it has to be set up to bridge the protocol.

1.5 Commercial DICOM devices on Separate Physical Networks

Other sites may choose to have a separate dedicated network for the commercial DICOM devices. In this case, the **V*IST*A** Imaging DICOM Gateway should have two network interfaces, one to connect the main hospital network backbone, and the second to connect to the dedicated network for the commercial DICOM devices (see Figure 1.5).

Separate Dedicated DICOM Network

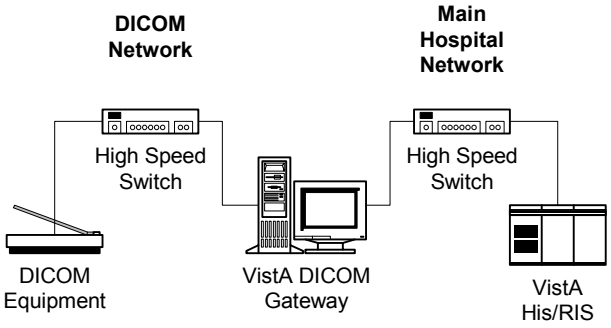


Figure 1.5

1.6 System Administration

The site should create a DICOM application user ID in their master domain for logging into the DICOM Gateways and running the imaging applications.

This user ID should not be in the administrators group on either the master or the resource domain. This will prevent security problems and avoid making any inadvertent changes to the master or resource domain.

It is not a good idea to use the resource domain administrator account for the purpose.

1.7 Documentation Conventions

The following conventions are used in this manual.

Convention	Description
Bold type	User Keyboard Entry.
<Enter>	Return key or Enter key.
<Control-x>	A keystroke that involves pressing the control-key, keeping it depressed, and then pressing another key.
<**SHIFT**>	Shift key.
<**ESC**>	Escape key.
<**Num Lock**>	Top left key on the numeric keypad (above the 7), may also be labeled Numeric Lock; this makes any keypad key activate the number shown on its surface; it is the equivalent of a SHIFT LOCK for alphabetic keys.

Chapter 2 Pre-Initialization Instructions

2.1 Hardware and Software Requirements

A site may have one or more PC's running the **V*IST*A** Imaging DICOM Gateway software.

It is assumed that a network be present with sufficient capacity to transport image files in a reasonable amount of time. See Appendix C for details about network set-up, which needs to be completed **before** any **V*IST*A** Imaging DICOM Gateway computer can be installed.

The hardware requirements for each processor are the same.

- The PC should have at least 128 megabytes of RAM and 4 or more megabytes of VRAM. A 17" (or larger) color monitor should be used configured to **1280 x 1024**, truecolor. This configuration is identical to the one used for a "Clinical Workstation" (Higher resolution, 1600 x 1200, or dual monitors is even better, since it provides more screen real estate on the workstaion and allows more windows to be visable at a time).
- Microsoft Windows NT Workstation, V. 4.0 with Service Pack 5, or later. The **NTFS** (NT File System) **must** be used and not the **FAT** (DOS File Allocation Table).
- Micronetics NT MUMPS (MSM-NT for Intel) 16-User license, with MSM NET-8, V. 4.4 or later.
- PC-Anywhere (32 bit version), V. 8.0 or later.
- Suitable, up-to-date virus protection software.
- Last, but definitely not least: **be sure** to have "administrator privileges" on any machine for the duration of the installation procedure.

Typically, it will take less than one hour to complete the entire installation process for one PC. Configuration and interfacing with DICOM devices will take additional time.

Caution: When performing an installation as an upgrade to an older installation of the **V*IST*A** Imaging DICOM Gateway, review Appendix B.4 for details about master files that may need to be upgraded manually.

Instructions for setting up the network between the various DICOM related processors and the **V*IST*A** system are described in Appendix C.

Instructions for adding a "modality" are described in the **V*IST*A** Imaging DICOM Gateway User Manual.

Instructions for creating icons to start components of the Gateway software are described in Appendix A.

2.2 Master Files and Software Required to Run the DICOM Applications

The **V*IST*A** DICOM software is distributed on a CD-ROM. (The distribution kit can also be downloaded across the network – see Section 3.4.) The file `\Manifest.txt` in the root directory of the CD-ROM contains a list of all the files that are part of the distribution. The directory `\Samples` contains a number of files that can be used to test that the software is properly installed. The directory `\Documentation` contains the manuals that accompany this software. The end-user should become familiar with the contents of both of these directories.

2.3 System Configuration and Global Placement

Some global variables are local to the DICOM Gateway, while other global variables are maintained on the **V*IST*A** system. The global variables that reside on the **V*IST*A** system are:

Name	Initial Size [MB]	Growth
`^MAGD`	0.1	Does not grow beyond 0.5 MB
`^MAGDAUDT`	0	1 MB per 250,000 studies
`^MAGDHL7`	0[1]	Should be purged when size exceeds 5 MB
`^MAGDOUTP`	0	Does not grow beyond 0.5 MB

`^MAGD` is for the "DICOM Correct" application. It contains information about every image file that fails a patient and study lookup on the main system. When manual corrections are made, the entries are deleted from `^MAGD`, so it does not continually grow.

`^MAGDAUDT` counts the number of different types of messages per day, as well as the number of images acquired from each instrument.

`^MAGDHL7` contains all of the HL7 messages passed from the HIS/RIS to the DICOM Gateway. The data in it can be periodically deleted, so that it will plateau to some maximum size and then be trimmed back.

`^MAGOUTP` contains the requests for DICOM Image transmission from **V*IST*A** to a remote Application Entity. Since the requests are deleted after being satisfied, the global remains very small.

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[1] For **V*IST*A** installations, the data for `^MAGDHL7` accrues as events happen in the system and HL7 messages are being transmitted.

Note: The global variables ^MAGDHL7 and ^MAGDWLST will be created as the system is being used, ^MAGDHL7 on the main **V*IST*A** System, and ^MAGDWLST on the **V*IST*A** DICOM Text Gateway System.

2.4 Resources (unique or unusual) Required for Software Product

The **V*IST*A** Imaging DICOM Gateway will require a high-speed network capability.

Storage of acquired images will require a multi-gigabyte storage capability (typically a juke-box).

2.5 Sizing Formula

In order to install all components needed to provide an operational system, the following amounts of disk space need to be available:

15 MB	MSM system
20 MB	DICOM database with MSM system
10 MB	Before Image Journal file
6 MB	Various utility programs
1 MB	Dictionary and Master files
52 MB	Total needed for installation

2.6 Recommendations for Software Installation and Testing

The installation procedure described in the following chapters involves the following steps:

2.6.1 For an "initial" installation

To install the **V*IST*A** Imaging DICOM Gateway on a new PC, perform the following steps:

1. Create a number of files and directories on the target system.
2. Create a number of icons on the target system.
3. Create MSM environment.
4. If MSM is not installed on a "C" drive, adjust internal registration of drive letter.
5. Enter information about Network Interface Card into MSM.
6. Establish a "DDP" connection between MSM and the main **V*IST*A** system.

7. Enter “translation table” information into MSM.

8. Establish master files containing site-specific information (lists of modalities, instruments, port numbers, and so forth).

9. Load master file information into MSM.

10. Create icons for the various instruments.

11. Establish MSM logon security.

Steps 1 through 7 above are described in Chapter 1; steps 8 through 11 are described in Chapter 4. Most of these steps can be executed in an automated fashion using the scripts from Chapter 1.

2.6.2 For an “upgrade” installation

Perform the following steps to upgrade an old version of the **V*IST*A** Imaging DICOM Gateway to the current revision:

1. Upgrade application software to current version.

2. Modify master files containing site-specific information to reflect all parameters that are required by the current version of the software.

3. Load master file information into MSM.

4. Create icons for any new instruments in the upgraded set-up.

Step 1 is described in Chapter 1; steps 2 through 4 are described in Chapter 4.

2.6.3 Software to be installed in the main VISTA System

In addition to software to be installed on the PCs, there is also software to be installed in the main **V*IST*A** system. This installation procedure is described in Chapter 5.

Chapter 3 Installation or Upgrade of the **V*IST*A** Imaging DICOM Gateway

3.1 Prerequisites for Getting Started

Before you proceed with the steps in this chapter, make certain that all of the following conditions are met:

- Windows NT™ V. 4.0 is installed on the target computer.
- Service pack 5 or higher for Windows NT™ has been applied.
- Suitable up-to-date virus protection software has been installed.
- The installer is logged in with full "administrator" privileges.
- The **V*IST*A** Imaging KIDS package must be installed. See the **V*IST*A** Imaging Installation Guide for details.

3.2 Setting up the Operating Environment

The *Microsoft Windows NT Workstation*™ is the operating system for the Image and Text Gateways. The following steps will generally make the use of the system easier.

1. Complete the installation of *Microsoft Windows NT Workstation*™.
2. Apply the latest approved Service Pack (currently, this is Service Pack 5; newer Service Packs are not yet approved for installation on the gateways and should not be loaded).
3. Upgrade *Internet Explorer ™* to the latest version (currently V. 4.01).
4. The system should be a member of the local resource domain, **VHAxxx**, where **xxx** are the three letters that identify the site.
5. Create a global group for the administrators of the **V*IST*A** Imaging DICOM Gateway computers. This group should be created in the master domain (the VISN's domain). The preferred name for this group is **VHAvv\xxx Image Admins**, where **xxx** are the three letters that identify the site and **vv** is the identification of the VISN (usually two digits). Perform this step on the Primary Domain Controller, as well as on the system being set up.
6. Create a User ID for the administrators of the **V*IST*A** Imaging DICOM Gateway computers. This User ID should be created in the master domain (the VISN's domain). The preferred name for this user ID is **VHAvv\VHAxxxIA**, where **xxx** are the three letters that identify the site and **vv** is the identification of the VISN (usually two digits).

7. Add the group **VHAvv\xxx Image Admins** to the local **Administrators** group. This will make it possible to use the Imaging Administrator ID to perform tasks such as adding the workstation to the local resource domain.

8. Create a global group for the users of the **V*IST*A** Imaging DICOM Gateway computers. This group should be created in the master domain (the VISN's domain). The preferred name for this group is **VHAvv\xxx Image Users**, where **xxx** are the three letters that identify the site and **vv** is the identification of the VISN (usually two digits).

9. Create a User ID for the users of the **V*IST*A** Imaging DICOM Gateway computers. This User ID should be created in the master domain (the VISN's domain). The preferred name for this user ID is **VHAvv\VHAxxxIU**, where **xxx** are the three letters that identify the site and **vv** is the identification of the VISN (usually two digits).

   Note: The preferred User ID is VHAxxxIU. This is to distinguish it from the Imaging User ID that must be created and used for the **V*IST*A** Imaging RAID storage system.

10. Verify that the group **VHAvv\xxx Image Users** has access to all Text and Image gateways and to all Background (Routing) processors. That is, make certain that this global group is added to the local **Users** group on each of these systems.

11. On the **V*IST*A** workstations, add the global group **VHAvv\xxx Image Admins** to the local **Administrators** group, and add the global group **VHAvv\xxx Image Users** to the local **Users** group.

12. Configure the Network Interface Cards (NICs) for usage through TCP/IP. **Do not** use Microsoft's DHCP to assign any addresses. For each system, hard-code a specific IP address and a default gateway address.

13. Make sure that the WINS/DNS information is defined according to the VA's national mandates.

14. If a local Domain Name Server (DNS) system is being used, make sure that this local DNS is the first DNS server in the list.

15. Make sure that the option is selected to use DNS for NetBIOS (WINS).

16. From this point forward, login as **VHAvv\VHAxxxIA** to perform the rest of the installation.

    Note: Any changes to the desktop are made only for the current account. If specific changes to the desktop are also needed for user accounts, first complete the installation, then login into the desired user accounts and make the desired changes in those accounts.

17. Install either **Remotely Possible** or **PCAnywhere 32** and set up the selected remote control application to use TCP/IP for its communication.

    Trouble-shooting: It may happen that the installation of **PCAnywhere32** adversely affects one of the video drivers (**\winnt\system32\awvideo.dll**). If this happens, a "blue-screen crash dump" will appear. In that case, first attempt to re-install the video driver. If that fails, copy a "good" version of `awvideo.dll` from an unaffected system.

18. Use "**Control Panel/Services**" to set up the communications service for the remote control package to start **automatically** (rather than manual) when the system is re-booted. Also, make sure that it will be using the System Account when starting automatically.

19. Set up a "host session" (a session that allows a remote support person to manipulate the system) and set the User-ID and password to be the same as those used on the Imaging FTP server.

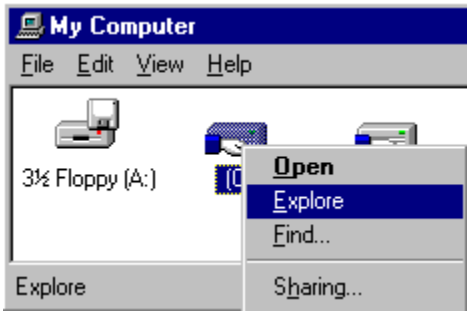
20. On a **V*IST*A** Imaging DICOM Gateway, one disk drive is designated to hold the data that is being moved between the various machines (this drive is often called the "**data drive**"). Set up the computer so that this drive is identified as **D:**. The boot partition should always be on logical drive **C:** (the first physical hard drive). Logical drive **D:** must be formatted as an **NTFS** partition.

3.3 Map a network disk to be the "F:" drive

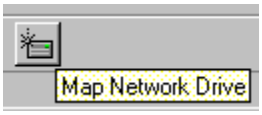
When only one single computer is to be installed at a site and this computer will perform all DICOM Gateway tasks, this step may be skipped. In a networked configuration with multiple DICOM Gateways, however, it is usually beneficial to use a "networked" drive to store the dictionary files and master files, so that all processors on the network can share the same resources. Such networked usage will also make future maintenance a lot easier. In the examples throughout this manual, the assumption is made that the "data" is mounted as drive "**f:**".

Double click on the icon labeled "**My Computer**".

In the window that pops up, right-click on any disk drive, and select "**Explore**".

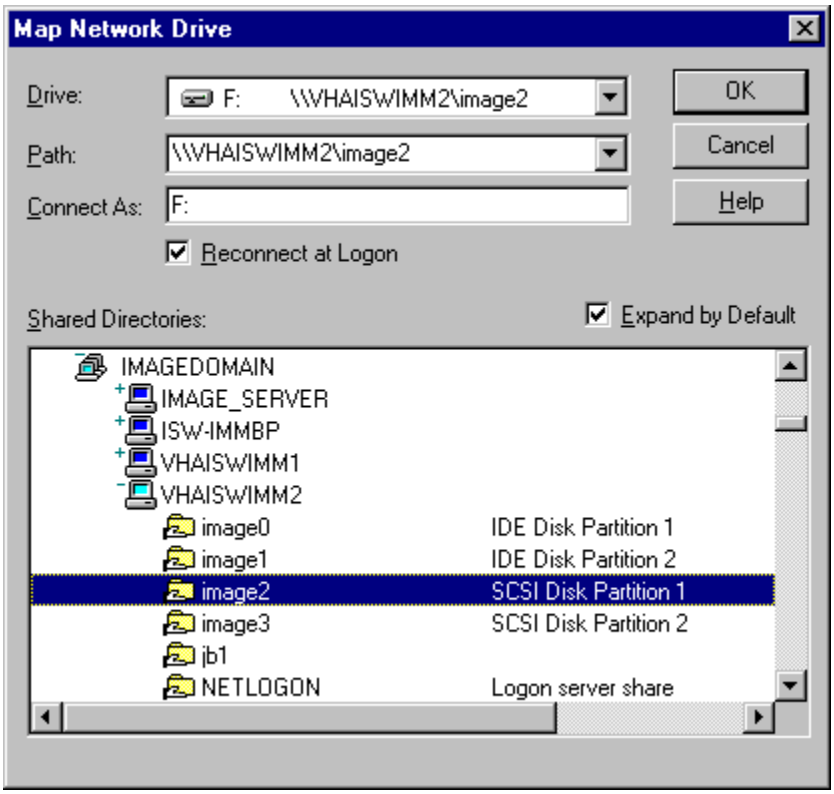


In the Explorer window, click on the button for "**Map Network Drive**".



and fill in the parameters that select a disk drive and directory that will be generally available to all processors that perform a task related to the **V***IST***A** Imaging DICOM Gateway.

The drive letter that is selected in this step, is the same drive letter that will be used as the "dictionary" drive.



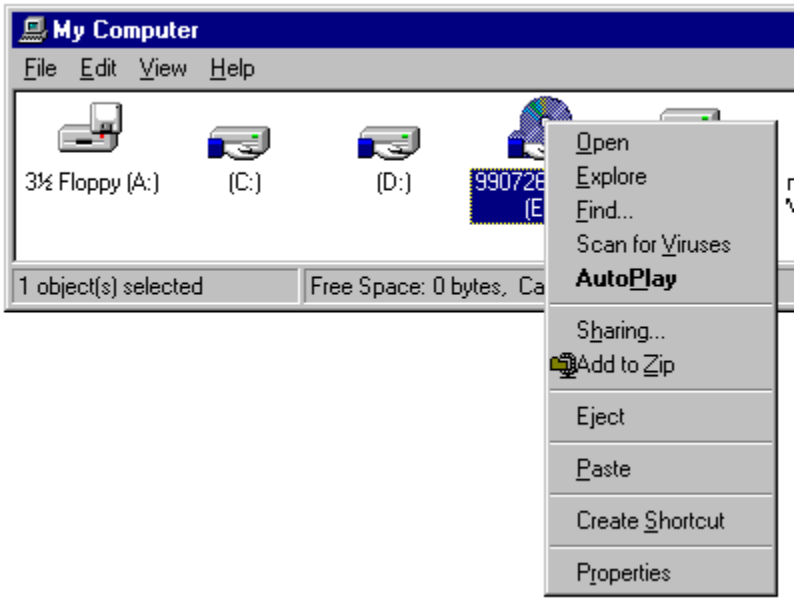
3.4 Getting Started

Note: This manual describes the distribution kit as if it is present on a CD ROM. The distribution kit may also be downloaded across the network (contact your Implementation Manager for details about access to network copies of the software). When the software is downloaded, it must be stored in a directory that can be mounted as a "shared" disk drive. This "shared" resource must then be mounted in such a way that the file "autorun.inf" appears in the root-directory of the network-mounted disk drive.

The VA distribution kit for the **V*IST*A** Imaging DICOM Gateway consists of a CD ROM and a printed copy of this manual. The CD ROM contains electronic copies of all the manuals for the **V*IST*A** Imaging DICOM Gateway in Adobe Acrobat™ format in the directory named "**Documentation**".

Insert the distribution medium into the appropriate drive, or "network mount" the "disk-share" that contains the software. Normally, the installation procedure will be started automatically. If this procedure is not automatically started…

1. Double-click on the icon labeled "My Computer".
2. Right-click on the icon for the CD-ROM.
3. From the pop-up menu, select the menu-option labeled "AutoPlay".



3.5 Automatic Start of the Installation Procedure

When the distribution CD-ROM is inserted into a drive on the target system, the installation procedure is usually launched automatically.

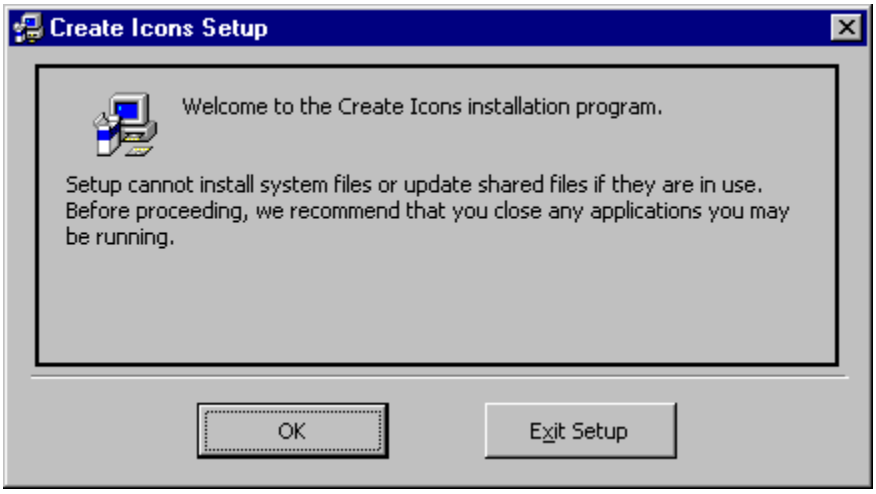
The installation procedure consists of three steps:

1. Install "Icon Creation" software.
2. Install **V***IST***A** DICOM Viewer software.
3. Install **V***IST***A** Imaging DICOM Gateway software.

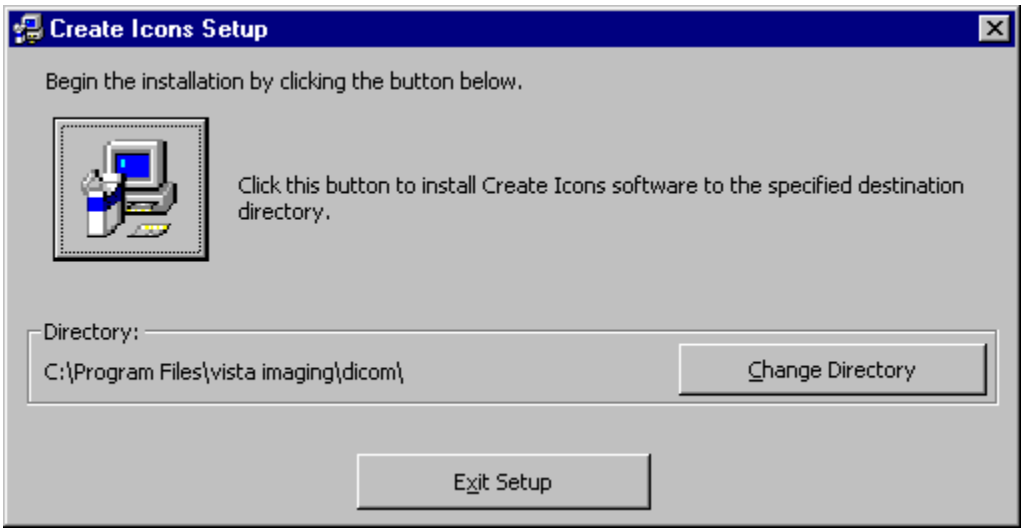
3.5.1 Icon Creation

The "Icon Creation" software installs a number of helper programs that will be used by the installation script to create icons. The progress through this part of the installation procedure involves mostly accepting defaults.

After the installation files are copied to the hard-disk, click on "**OK**" to start the installation procedure.

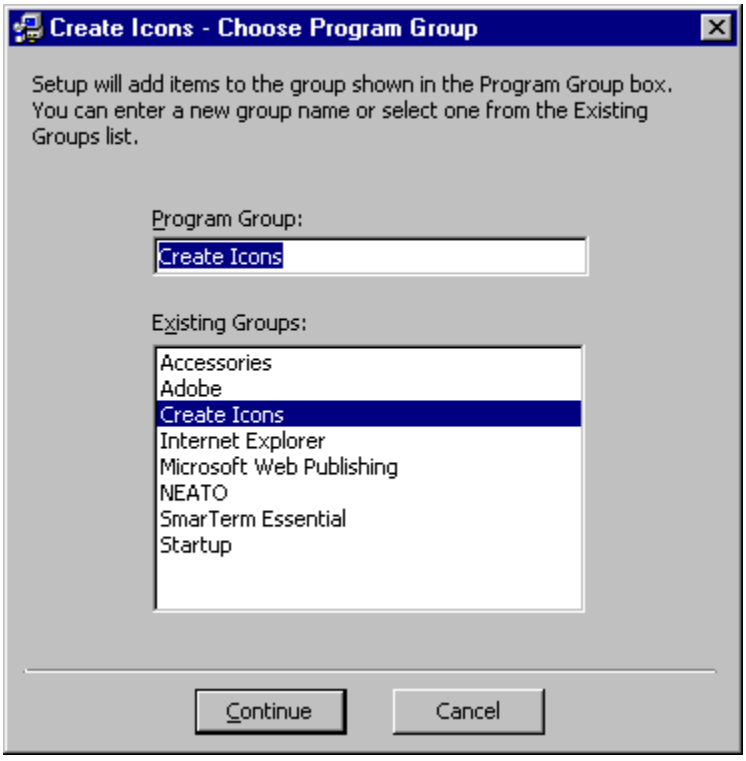


In the next window that pops up,

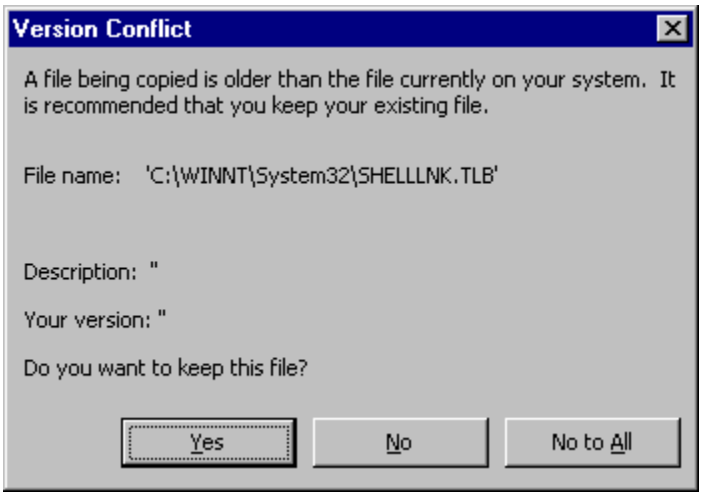


press on the button with the icon for "set-up" to continue the installation process.

In the next window, press on the "**Continue**" button:



If the following window appears:



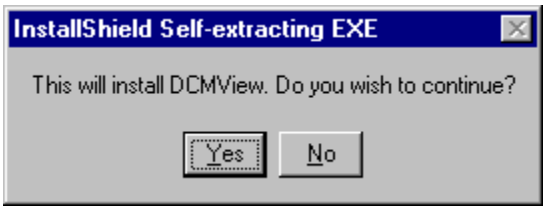
Click on "**Yes**" to make sure that existing library files are not overwritten.

After this, the installation process will signal successful completion.

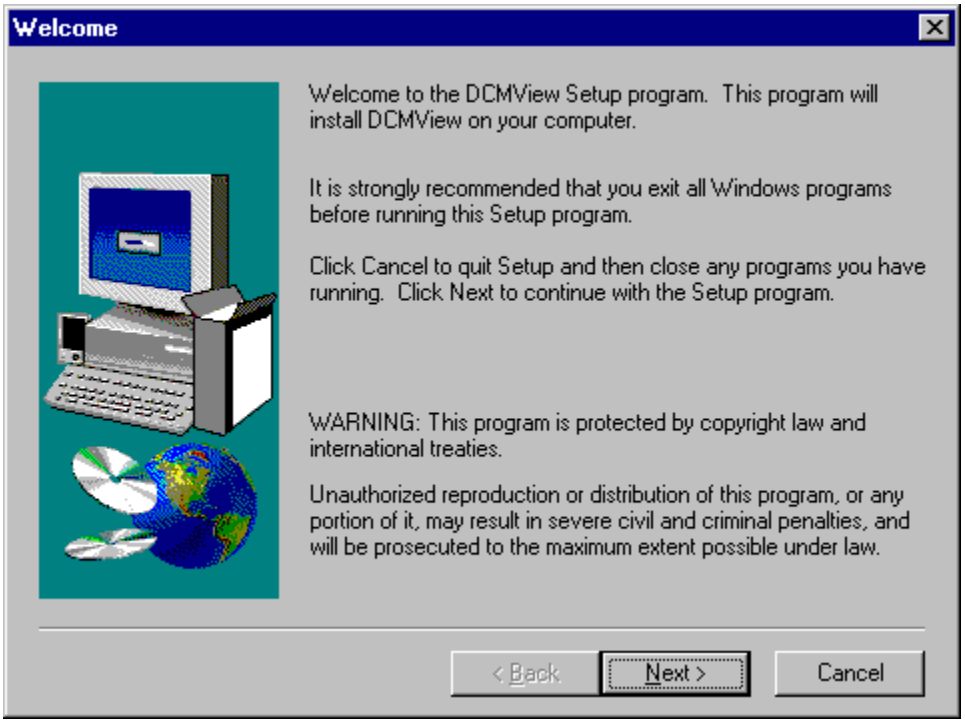
Click on "**OK**" to proceed with the next step.

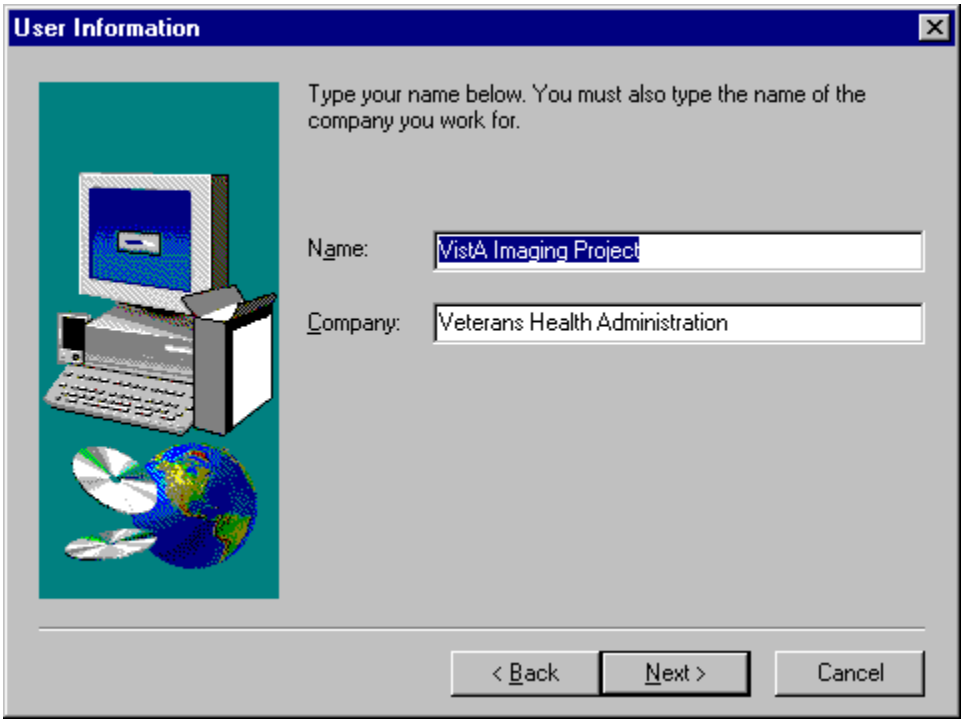
3.5.2 VistA DICOM Viewer

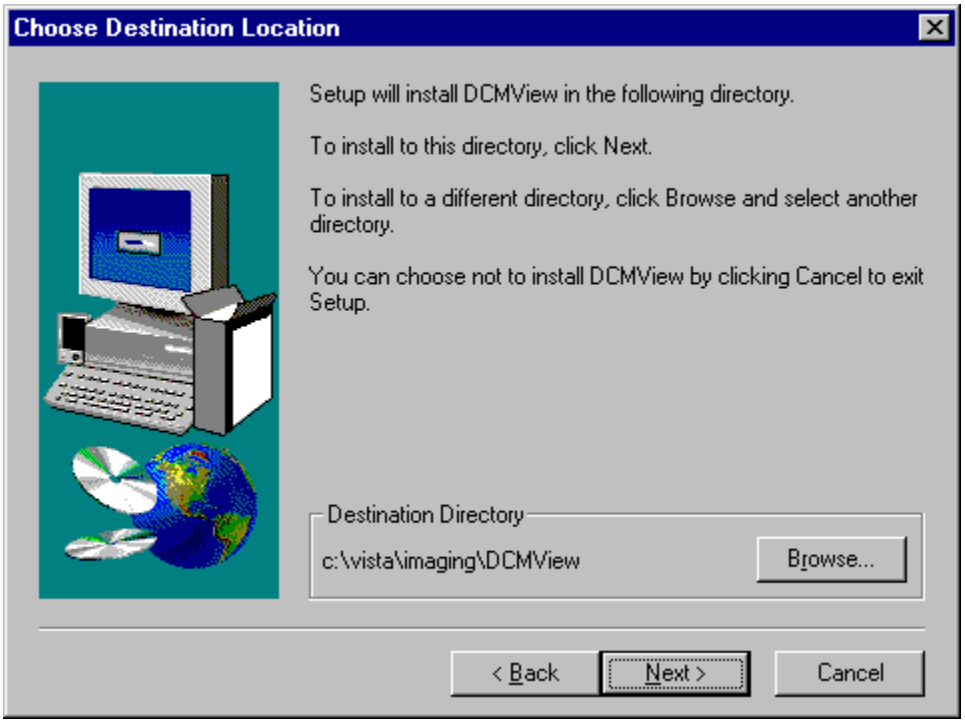
The "**VistA** DICOM Viewer" is software that makes it possible to display DICOM images on a workstation. Click on "**Yes**" to install this software (**only** click on "No" to skip this part of the set-up process when the latest version of the **VistA** DICOM Viewer is already installed).

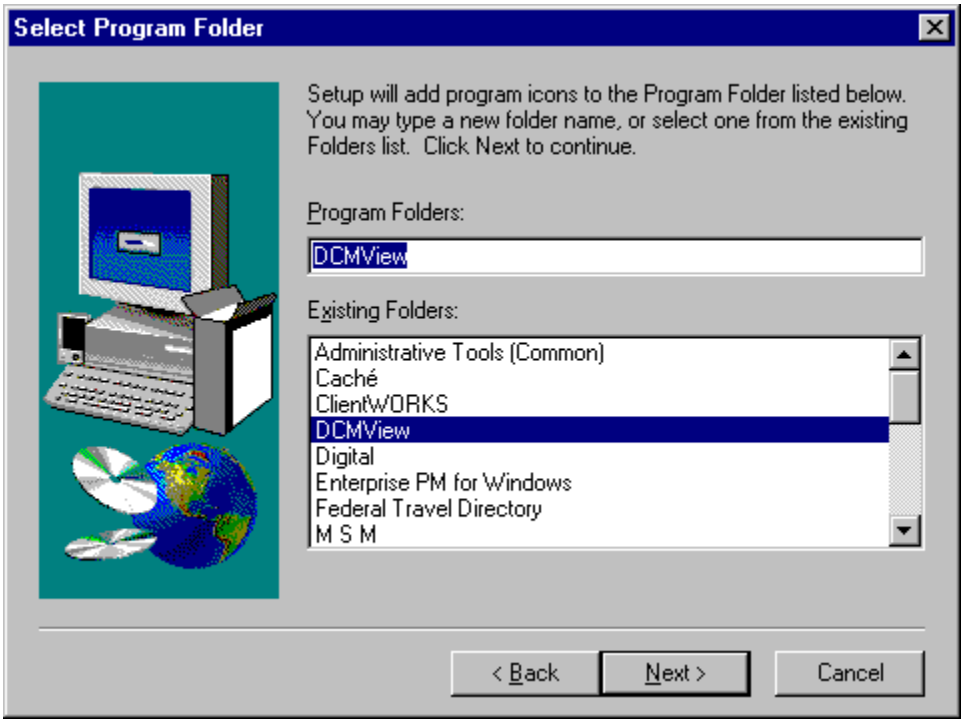


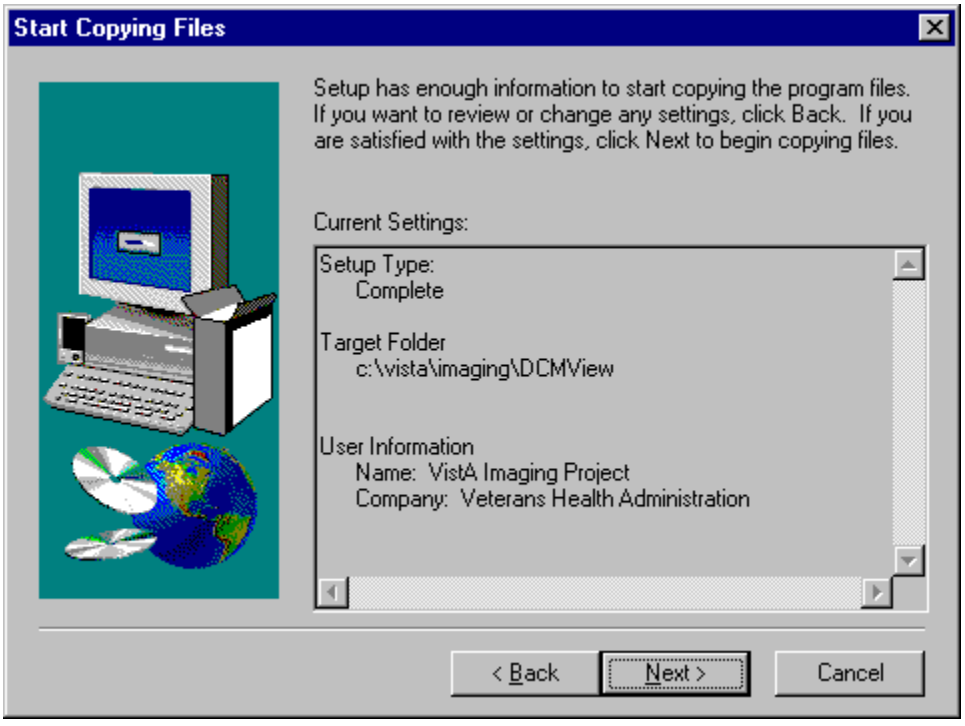
This part of the installation procedure consists mostly of accepting defaults. In the next five windows, press on the "**Next**" button.



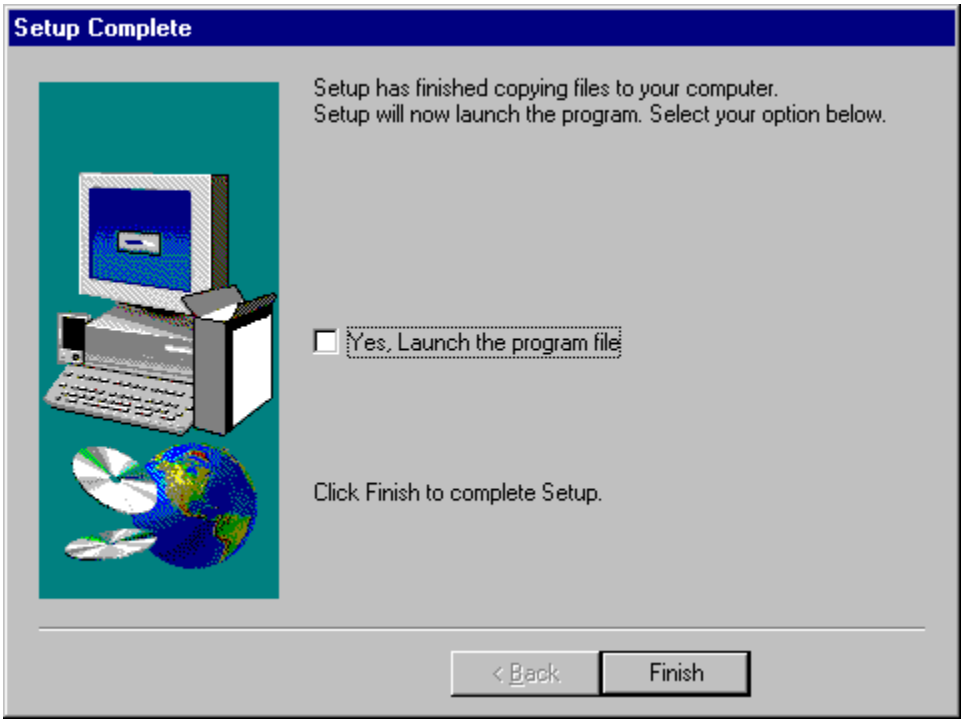

User Information
Type your name below. You must also type the name of the company you work for.
Name:
VistA Imaging Project
Company:
Veterans Health Administration
< Back
Next >
Cancel


Choose Destination Location
Setup will install DCMView in the following directory.
To install to this directory, click Next.
To install to a different directory, click Browse and select another directory.
You can choose not to install DCMView by clicking Cancel to exit Setup.
Destination Directory
c:\vista\imaging\DCMView
Browse...
< Back
Next >
Cancel





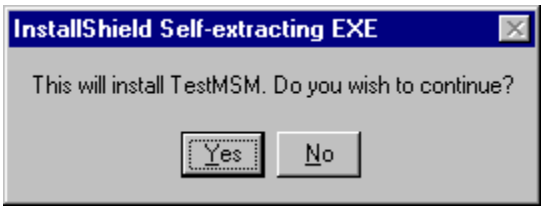
And, in the final window of this sequence, click on "**Finish**" to complete this step.



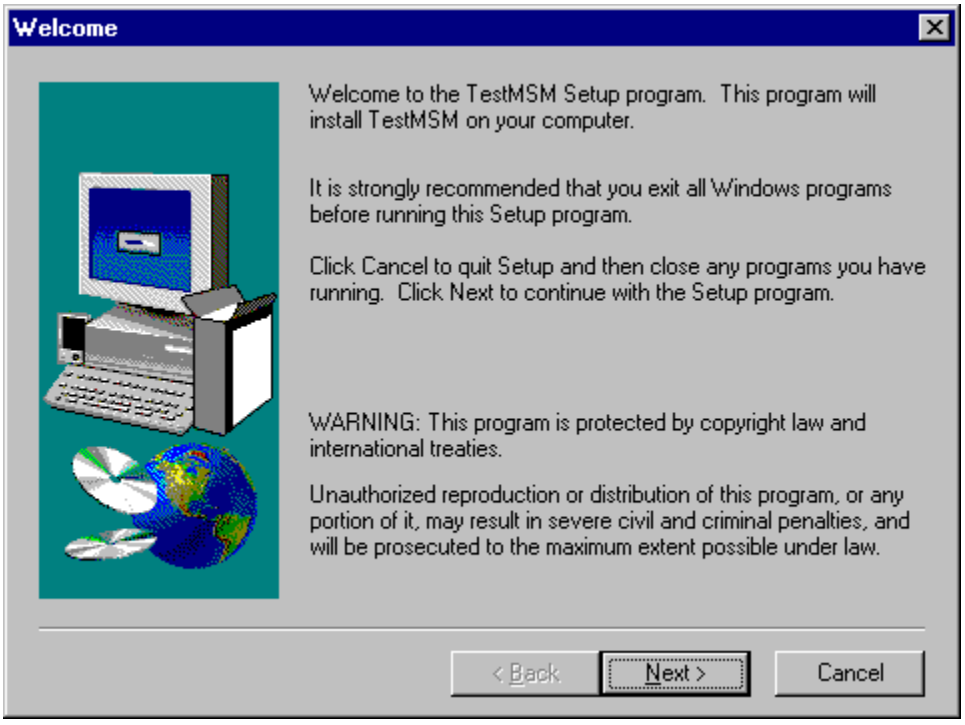
3.5.3 V*IST*A DICOM Test MSM Software

The "**V*IST*A** DICOM Test MSM Software" is a program that is used by the DICOM Gateway software to check whether or not MSM is already running. This software is used to prevent problems that result from starting multiple instances of the MSM software.

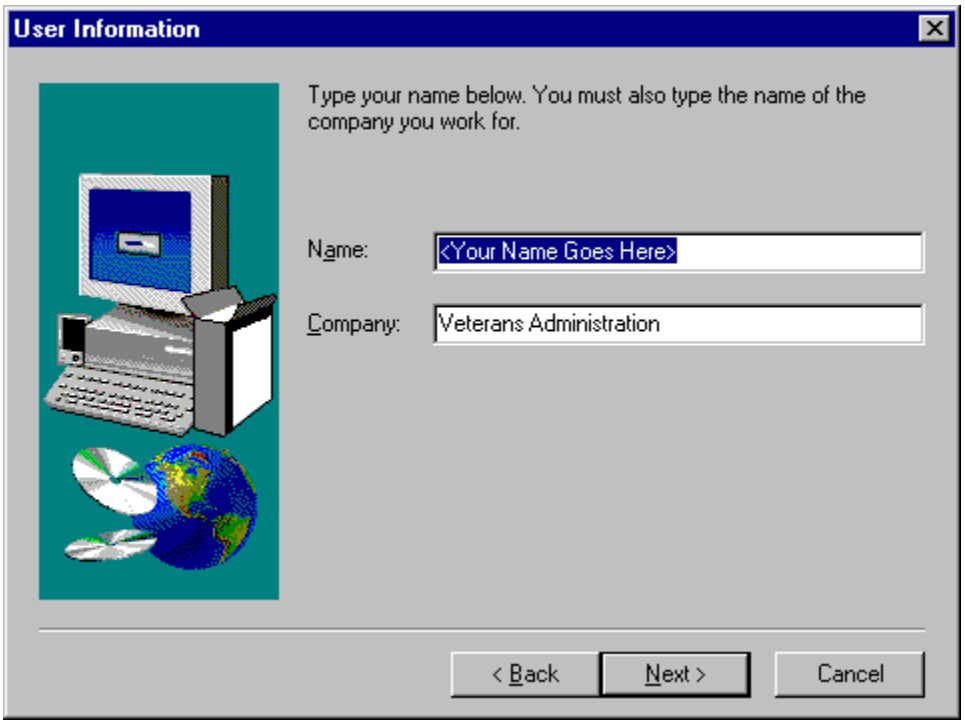
This part of the installation can usually be executed by accepting all defaults.



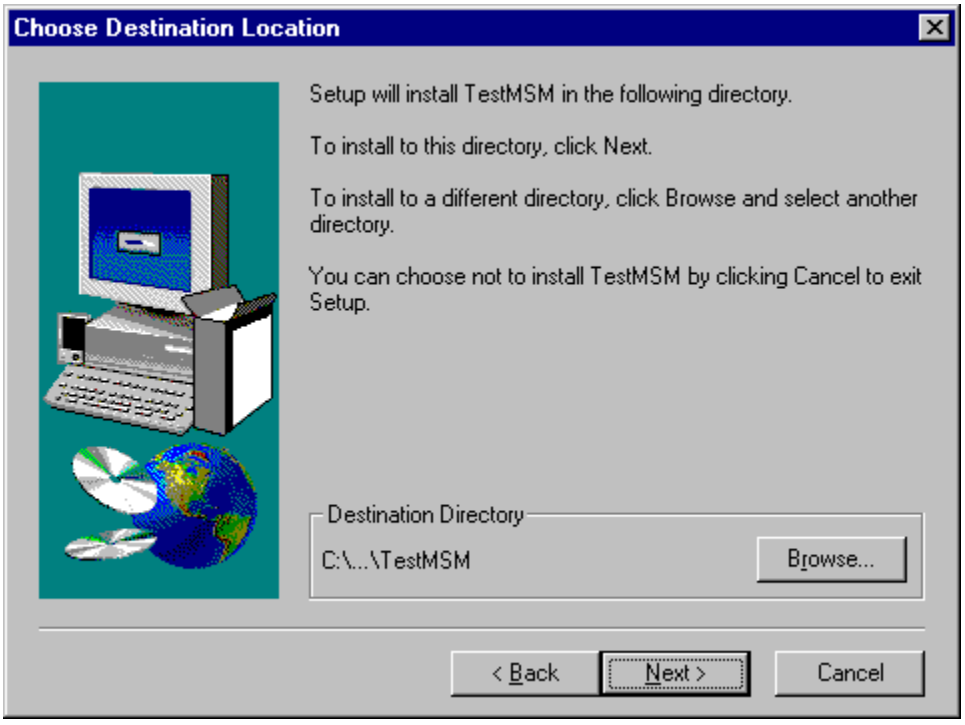
Press "**Yes**" to continue.



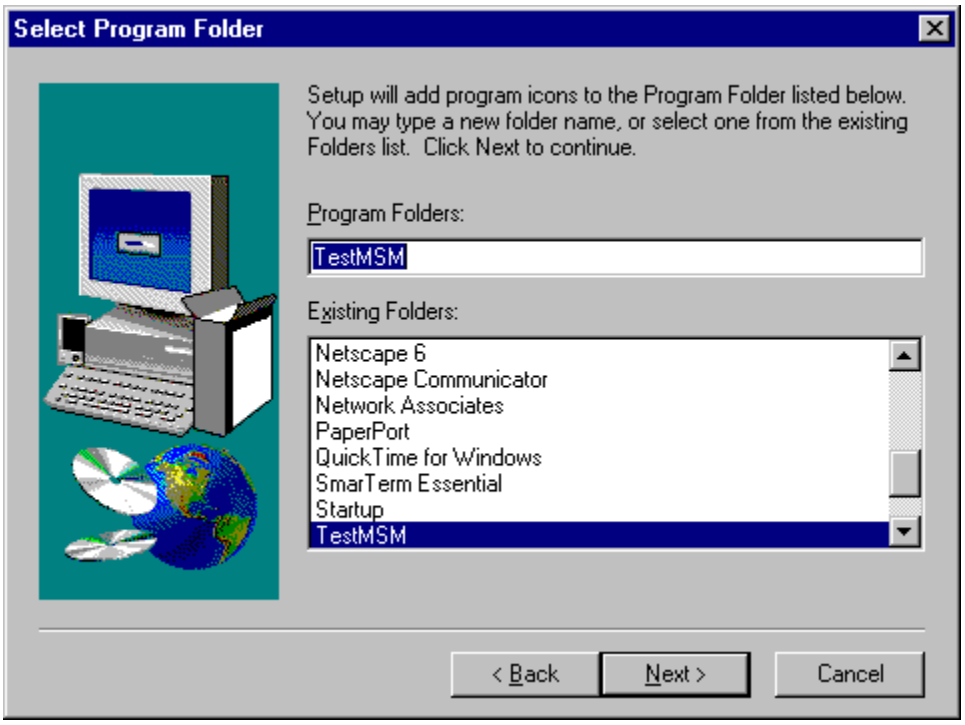
Press "**Next**" to continue.



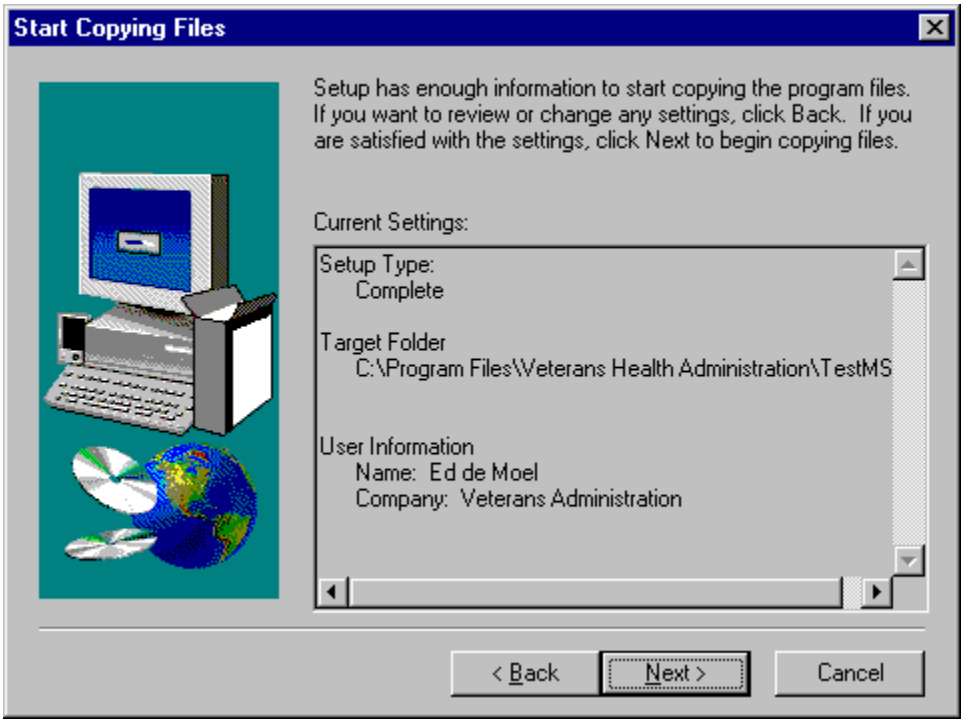
Fill in the appropriate name, and press "**Next**" to continue.



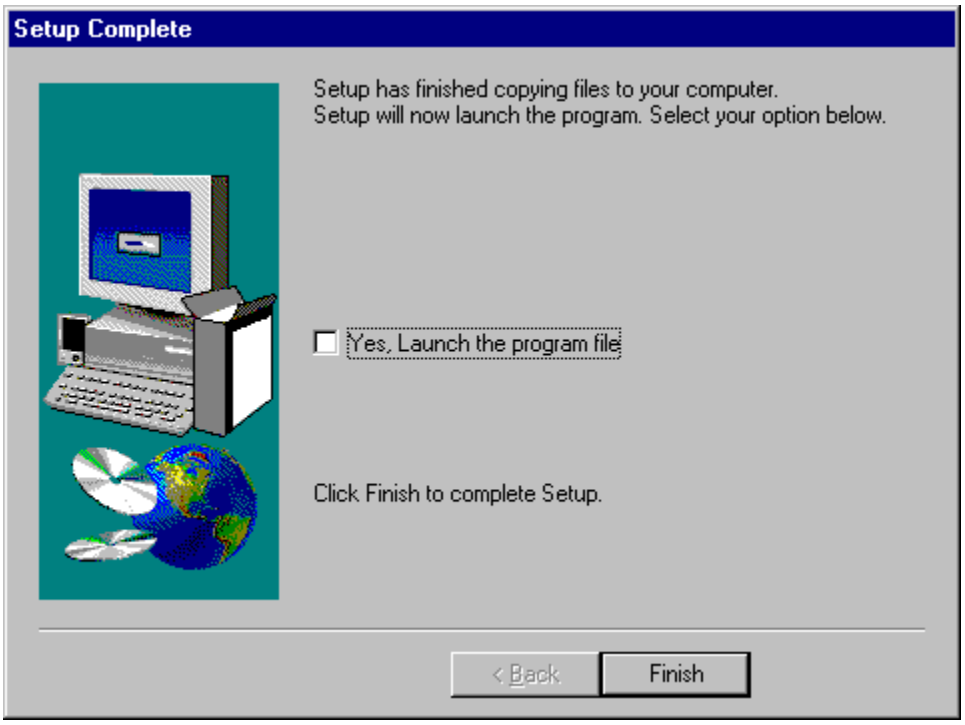
Press "**Next**" to continue.



Press "**Next**" to continue.



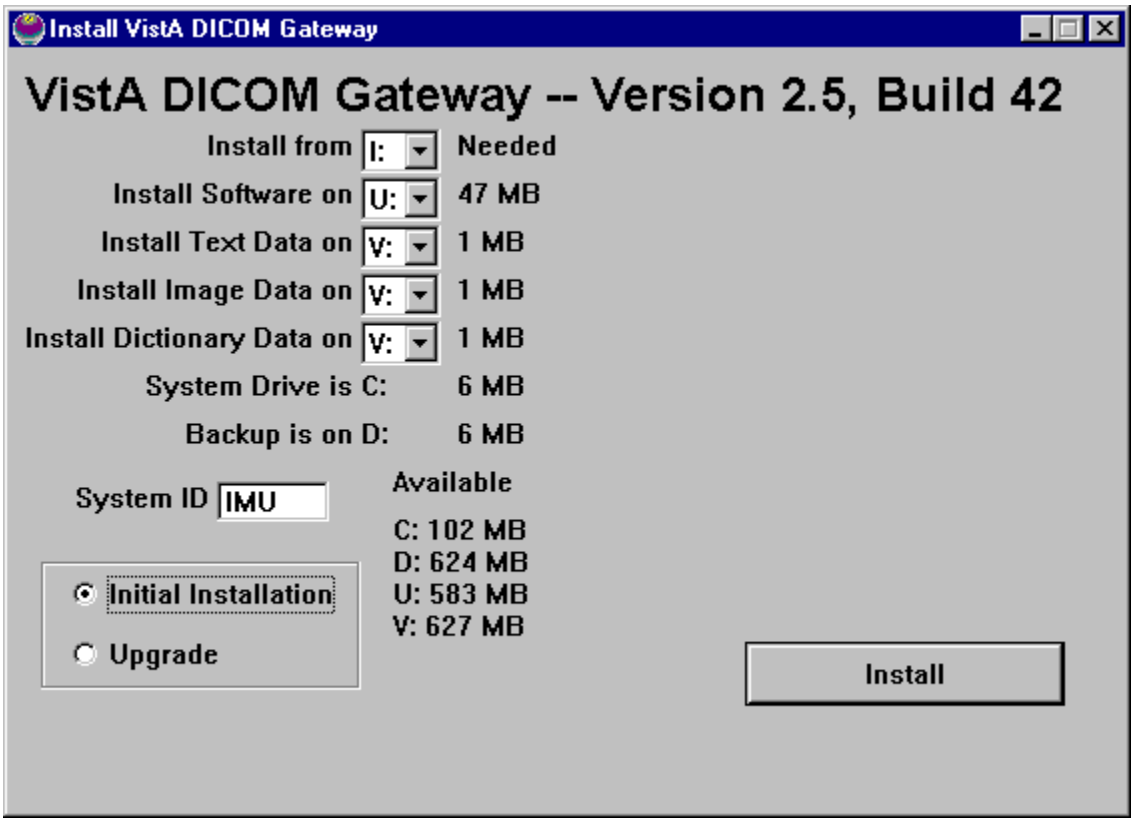
Press "**Next**" to continue.



Do not check the box, and press "**Finish**" to complete this installation step.

3.5.4 V*IST*A Imaging DICOM Gateway

In the dialog-window for the installation of the **V*IST*A** Imaging DICOM Gateway the end-user can modify the various boxes to correspond with the desired type of installation (A number of default values will already be filled in.).



The boxes that may be modified to fine-tune the installation are described below.

3.6 "Install from" Drop-down List

This drop-down list allows the installer to specify the name of the disk drive from which the software is to be installed. The default value is the name of the drive holding the CD-ROM.

3.7 "Install Software on" Drop-down List

This drop-down list allows the installer to specify the name of the disk drive on which the MSM database is to be installed. The default value is **C:**.

Note: Those programs that need to be generally available will be loaded into drive:\Program Files\VistA\Imaging\DICOM (where the drive-name is the name of the drive where the operating system is installed).

3.8 "Install Text Data on" and "Install Image Data on" Drop-down Lists

These drop-down lists allow the installer to specify the name of the disk drive on which the DICOM data files are to be installed. The default value for these is **C:**.

3.9 System ID

This text box allows the installer to identify the current system and database.

The distributed database is named "**IMA**". When there is the only one **VISTA** Imaging DICOM Gateway, this name is appropriate. When multiple systems are present at a site, it is customary to name the first gateway processor "**IMA**", the second one "**IMB**", further ones "**IMC**", "**IMD**", and so forth.

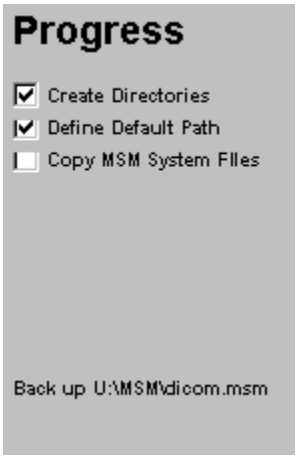
3.10 Initial Installation or Upgrade

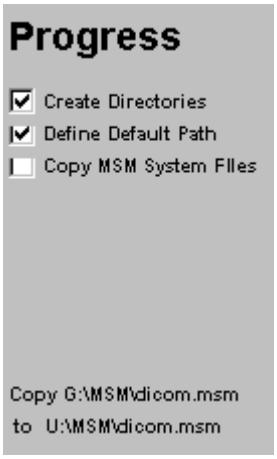
This radio button allows the installer to specify whether the current installation is an initial installation, or an upgrade. When a letter is selected for the drive on which the MSM system is to be installed, the installation procedure will check whether or not a current database is present. When a database is present, the default value for this button will be "**Upgrade**", otherwise the default value will be "**Initial Installation**".

Note: Perform an "Initial Installation" only when there is no valid data in the database on the current system. When a database is present, it is possible to change the value of the radio button to "Initial Installation". Be aware that all data in the existing database will be irrecoverably lost when the existing database is overwritten.

3.11 Progress Indicators

When the "**Install**" button is pressed, the installation or upgrade will be started. During the process of installing or upgrading software, a number of progress indicators will be visible in the window.

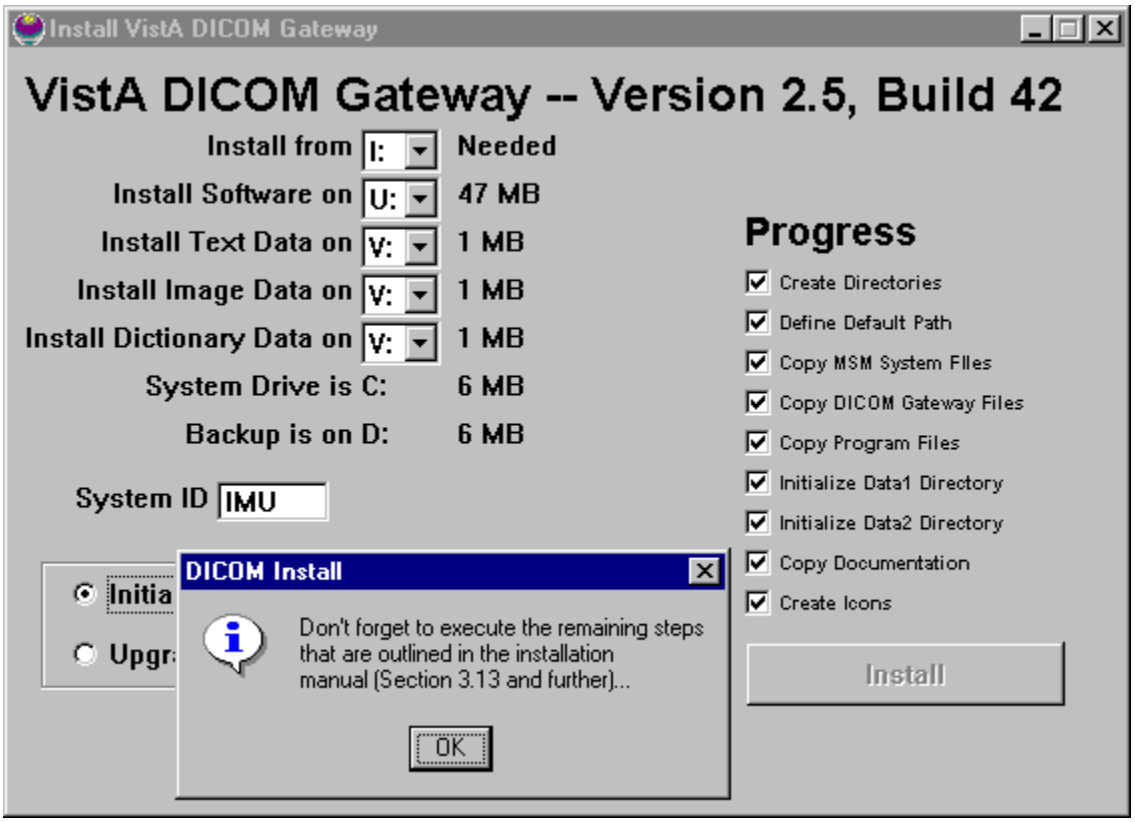




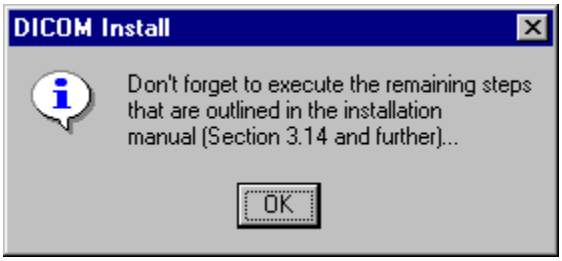
On the left hand side of the window, check boxes will appear each time when the process starts a new stage, and a check-mark will become visible in these boxes when the stage is completed successfully.

At the bottom of the window, any details about the progress of the current stage may be displayed. While the installation procedure is copying files onto the target system, it will check whether any new files are already present. Files that are already present on the target system will be backed up before the new files are installed.

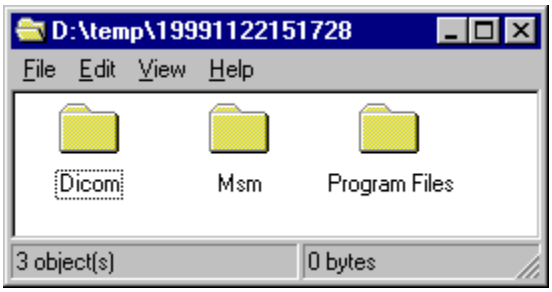
When all stages have been completed, the installer may close the window by pressing either the "**Cancel**" button on the window, or the "**X**" button in the title bar.



When the automated part of the installation process is completed, a window will pop up that reminds the installer to perform the manual steps that are described later in this manual. (After an initial installation, proceed with section 3.13 and after an upgrade, proceed with section 3.14.)



Any "backed up" files that were created during an installation or upgrade can be found in a subdirectory of the "TEMP" directory. The name of this subdirectory will consist of only digits, and represents the date and time when the installation started (the format is yyyymmddhhmmss, year, month, day, hour, minute, second).



In this directory, the various subdirectories contain the files that were saved before they were overwritten.

3.12 Trouble shooting, if necessary

It may be that the final section of the installation procedure did not work as shown above. The most likely error to occur in that stage is that the operating system does not have a recent enough version of Microsoft OLE Automation.

If, and only if, the final section of the procedure above showed errors that indicate that the file OLEAUT32.DLL is out of date, run the command file **OLE.BAT** from the distribution CD ROM, as described below.

Note: If the warning about OLEAUT32.DLL appears, it will be repeated quite a number of times. Do click "**OK**" at every instance of the warning, so that the installation procedure will terminate "normally".

Warning: Running this script file when the current system has a more recent version of OLEAUT32.DLL than the distribution CD ROM, may ***seriously impair*** the operation of the system.

Start this script either by double-clicking on the icon,

or by starting it from the (DOS) command shell.

Sample session:

```
E:\xxxx> cd \ <Enter>
```

```
E:\> ole <Enter>
E:\>echo off

Install VISTA Imaging DICOM Gateway Software
Version 2.5


Enter drive-letter for source drive [E]: e <Enter>
Enter drive-letter for destination drive [C]: d <Enter>
Enter drive-letter for data drive [D]: F <Enter>
Source is E: and destination is D:.
Data is stored on F:.
System Drive is C:.
Press any key to continue . . . <Enter>
   1 File(s) copied
. . .
   1 File(s) copied
Press any key to continue . . . <Enter>

E:\>
```

In some cases, another error related to OLEAUT32.DLL may occur while running the script file OLE.BAT. The exact text of this error message will depend on the version of Windows NT that is currently being used, and cannot be predicted. When this happens, reboot Windows NT, and run the script file **OLE.BAT** again. This time, the script should run without any error messages. If, at this third iteration, there still is an error message, call customer support.

3.13 Initial Installation Only (NOT Upgrade)

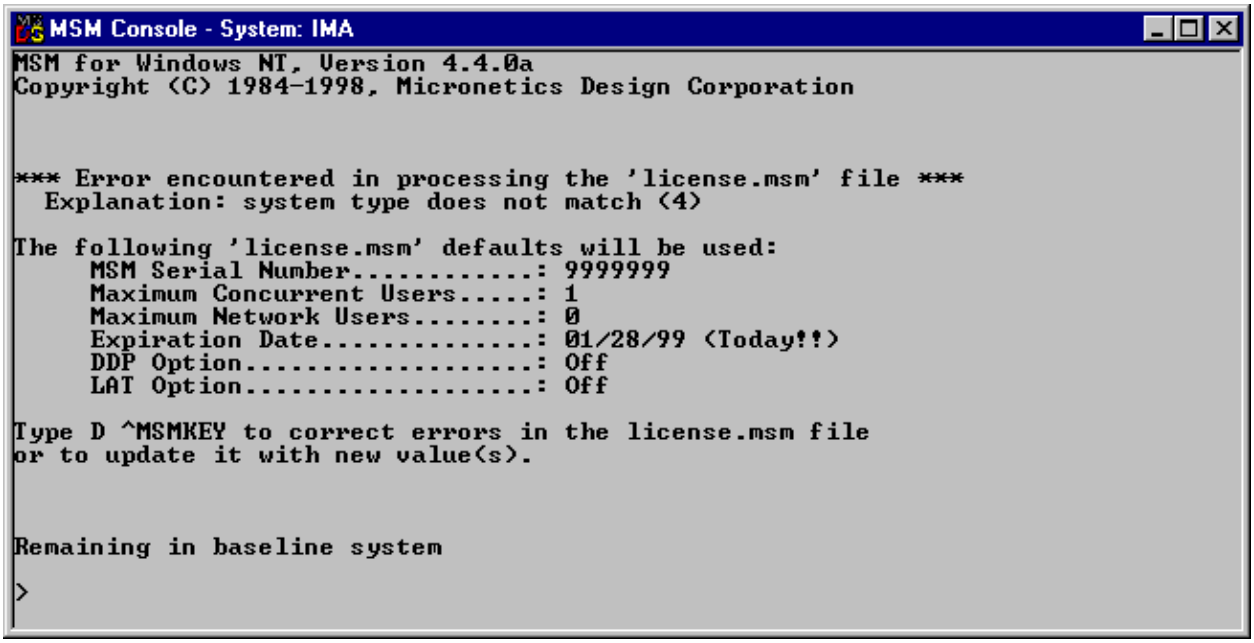
The following steps are only performed for the initial installation and not for an upgrade. Skip the following steps and proceed directly to Section 3.14 for an upgrade.

Perform the following steps and those in Section 3.14 for the initial installation.

3.13.1 Activate MSM

MSM may be started from the DOS command prompt by changing directory to **drive:\MSM** and then starting the application: "**msm**".

The first time that MSM is started, it will produce the notification that no current license is available. Enter the license information from the "paper key" that was provided by the supplier of MSM.



3.13.2 Enter MSM License Key Information

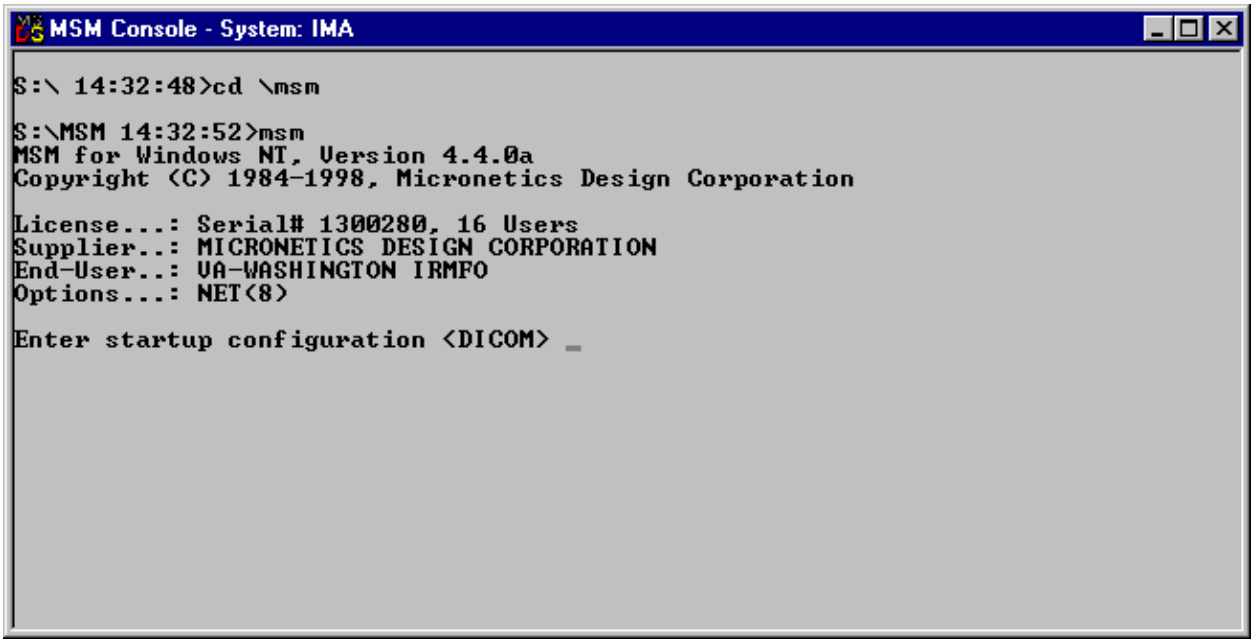
Start the license registration program by entering:

Note: The actual license key to be used should be one that applies to the current site and the current processor. The license key in the dialog below is shown for informational purposes only.

```
>DO ^MSMKEY <Enter>

Activation Code: XXXX;XXXX;XXXXXX;X;XX;X;XXXXX;X;X;X;X;X <Enter>

Supplier: XXXXXXX CORPORATION <Enter>

End-User: VA-XXXXXXXX <Enter>

Please verify:
     Activation Code..: XXXX;XXXX;BDNHDI;A;BA;J;BHBIG;I;CF;E;A;A
     Supplier.....: MICRONETICS DESIGN CORPORATION
     End-User.....: VA-WASHINGTON IRMFO

OK to apply <Y>:

Key parameters are different from existing key.  MSM must be
restarted for this key to be applied.

Do you want to shut down the system now <N>: Y <Enter>

Shutdown initiated

Exit

C:\MSM>
```

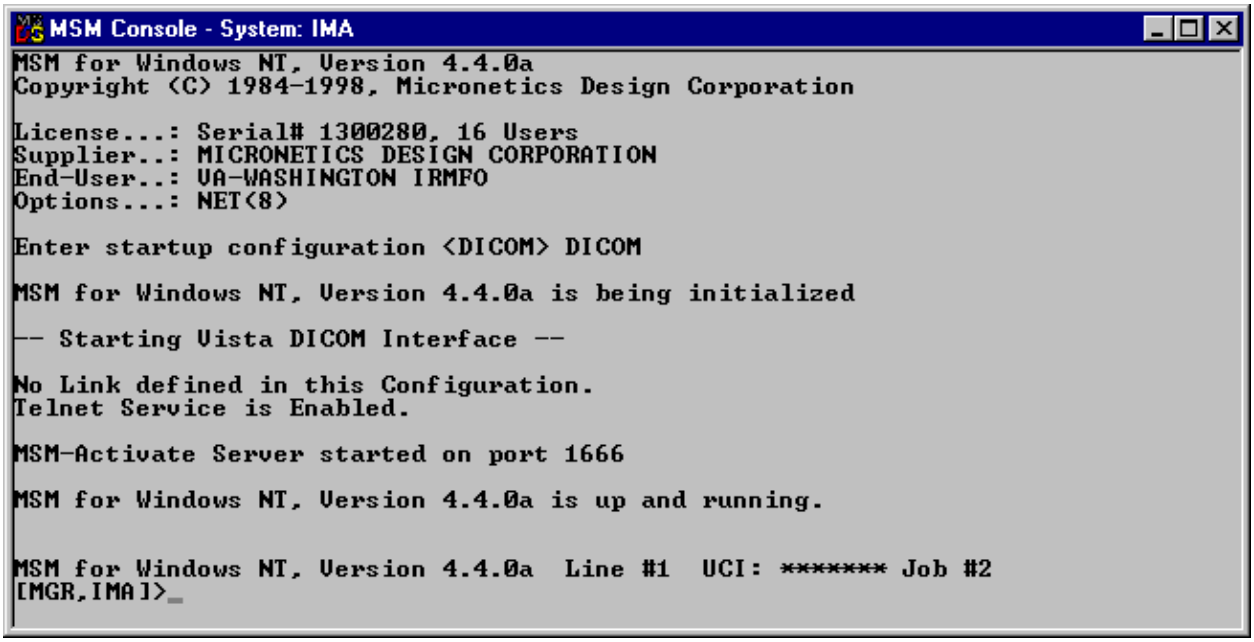
3.13.3 Start MSM

MSM may be re-started by entering "**msm**" from the command prompt:



When MSM asks which configuration to start up, accept the default by just pressing the "**Enter**" key.

Several other initialization messages will appear:



When the system has started up, the prompt for a log-in will appear:

```
MSM for Windows NT, Version 4.4.0a  Line #1  UCI:
```

At this prompt, enter the text "**MGR:XXX**" (and then press the Enter key). This text is treated as a password and will be "echoed" as asterisks only.

3.13.4 Define a DDP Link

Communications with the main **V***IST***A** Hospital Information System use the **D**istributed **D**ata **P**rocessing (DDP) protocol. This step selects the network adapter to be used for DDP.

The MSM system will start up and will notify the user that "no links are defined". The definition of a "link" is dependent on the type of network adapter that is present in the computer, and must be done at this stage.

Note 1: If there is only one Network Interface Cards (NICs) installed, the question "Adapter Card Name" in the dialog below will offer the name of that one card as the default response. When there are multiple cards, it is important to respond with the name of the card that provides the connectivity to the **V***IST***A** system.

Note 2: When a new network card is installed in a PC, MSM typically will not "see" that card until after a "cold re-boot" (shut down, power down, power up and restart) has been performed.

The **SYSGEN** program defines information about DDP links as shown below:

```
[MGR,IMA]>Do ^SYSGEN <Enter>

          MSM - System Generation Utility

Select SYSGEN Option:

    1 - Display Configuration Parameters
    2 - Create New Configuration
    3 - Edit Configuration Parameters
    4 - Edit Configuration Name/Comment
    5 - Delete Configuration
    6 - Set Default Startup Configuration
    7 - UCI Management
    9 - System Configuration Parameters
   10 - Database Definition
   12 - Device Translation Tables
   13 - Mnemonic Namespaces
   14 - Journaling Management

Select Option: 3 <Enter> - Edit Configuration Parameters

Select Configuration <DICOM>: <Enter> DICOM

Select SYSGEN Option:

    1 - SYSGEN (step through full SYSGEN)
    2 - Backspace, Line Delete Character
    3 - Autostarts and Automounts
    4 - Maximum Partitions
```

```
    5 - Security
    6 - Tuning Parameters
    8 - Tied Terminal Table
    9 - Port (Terminal) Definition
   11 - External Calls Configuration
   12 - Default Partition Size
   13 - Translation/Replication Table Maintenance
   15 - Network Configuration
   16 - Tape Device Definition
   17 - Global Defaults
   18 - LOCK Table Size
   19 - Display Configuration Parameters
   20 - Mode Flags

Select Option: 15 <Enter> - Network Configuration

Available Functions:

    1 - DDP System Parameters
    2 - Link Definition
    3 - Circuit Definition
    4 - DDP Groups
    5 - Network Security
    6 - LAT System Parameters
    7 - LAT Node Management
    9 - OMI Translation Table
   10 - Display Network Configuration
   11 - Workstation Server Configuration
   12 - User-Defined Services
   13 - Telnet Service Configuration
   14 - MSM-Activate Service Configuration
   15 - PDQWeb Service Configuration

Select Option: 2 <Enter> - Link Definition

Select Link Number: 1 <Enter>

Link Type:

     1 - MSM Data Link
     2 - TCP/IP
     3 - UDP/IP
     4 - IPX

Select Link Type <1>: 1 <Enter>

Adapter Card Name <DC21X41>: <Enter>
```

Note: The name of the adapter card that will actually be shown is the name of the card that is recognized by the software as the network interface. If only one network interface is physically present in the computer, this default value must be accepted. When multiple ones are present, consult with the network specialist at the site as to which is intended to be used for "DDP communications".

```
Current Links Defined:

Link   Device Name       Port Number    Network Mask        IP Address
----   -------------     -----------    ---------------     ---------------
  1    DC21X41
```

```
Select Link Number:

Available Functions:

    1 - DDP System Parameters
. . .
   15 - PDQWeb Service Configuration

Select Option: <Enter>


Select SYSGEN Option:

    1 - SYSGEN (step through full SYSGEN)
. . .
   20 - Mode Flags

Select Option: <Enter>

Select SYSGEN Option:

    1 - Display Configuration Parameters
. . .
   14 - Journaling Management

Select Option: <Enter>
[MGR,IMA]>
```

3.13.5 DDP Group

The communication through DDP is partitioned into "groups". Computers can only communicate though DDP when both systems subscribe to the same DDP "group". The installation database is shipped with settings that subscribe to groups 0 and 15 (the most common settings for **V*IST*A** systems).

Consult with the **V*IST*A** IRM staff to find out what the appropriate DDP group is for the main **V*IST*A** system. If the group number is **0** or **15**, no changes need to be made to the distributed database. If the group number is a different one, e.g. 7, follow the dialog shown below to enter the appropriate group number.

```
[MGR,IMA]>Do ^SYSGEN <Enter>

          MSM - System Generation Utility

Select SYSGEN Option:

    1 - Display Configuration Parameters
. . .
    3 - Edit Configuration Parameters
. . .
   14 - Journaling Management

Select Option: 3 <Enter> - Edit Configuration Parameters

Select Configuration <DICOM>: <Enter>DICOM

Select SYSGEN Option:
```

```
    1 - SYSGEN (step through full SYSGEN)
. . .
   15 - Network Configuration
. . .
   20 - Mode Flags

Select Option: 15 <Enter> - Network Configuration

Available Functions:

    1 - DDP System Parameters
. . .
    4 - DDP Groups
. . .
   15 - PDQWeb Service Configuration

Select Option: 4 <Enter> - DDP Groups

This system currently belongs to the following DDP groups:
0, 15

Enter DDP Group Number: -0 <Enter>    ...membership to group 0 deleted

Enter DDP Group Number: -15 <Enter>   ...membership to group 15 deleted

Enter DDP Group Number: 7 <Enter>     ...membership to group 7 added

Enter DDP Group Number: <Enter>

Available Functions:

    1 - DDP System Parameters
. . .
   15 - PDQWeb Service Configuration

Select Option: <Enter>


Select SYSGEN Option:

    1 - SYSGEN (step through full SYSGEN)
. . .
   20 - Mode Flags

Select Option: <Enter>

Select SYSGEN Option:

    1 - Display Configuration Parameters
. . .
   14 - Journaling Management

Select Option: <Enter>
[MGR,IMA]>
```

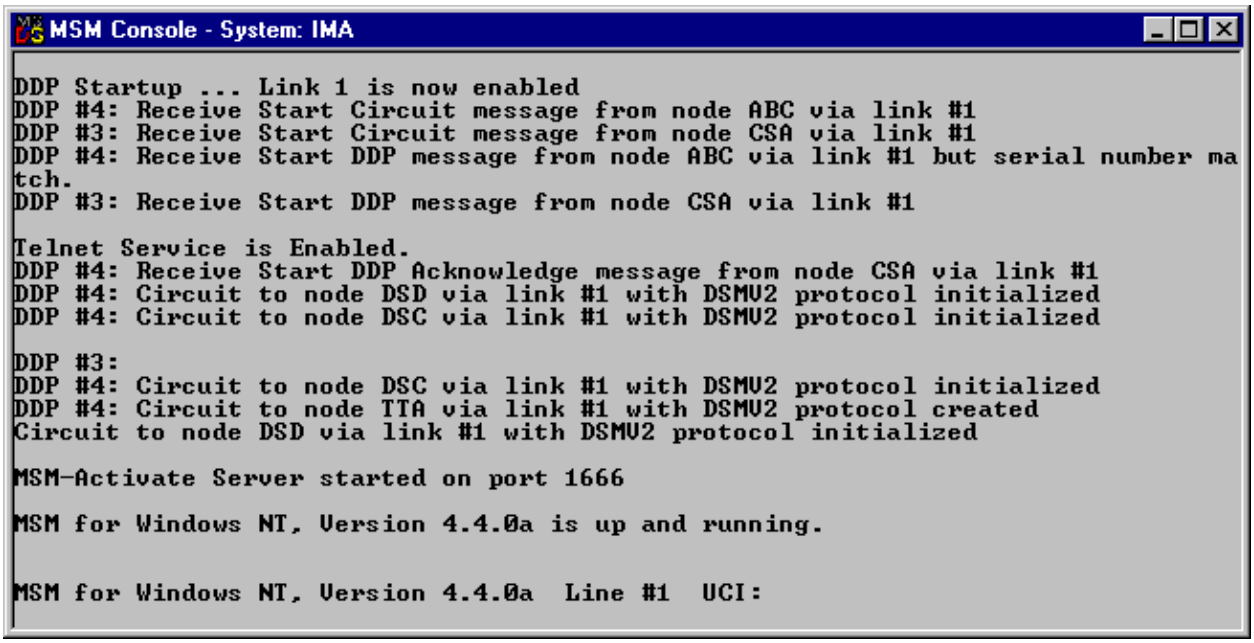
3.13.6 Restart MSM, verify that connections are established properly

At this point, the system needs to be restarted, so that network connections can properly be initialized. First shut down MSM.

```
[MGR,IMA]>Do ^SSD <Enter>


          MSM - System Shutdown


Ok to proceed <N>? Y <Enter>

Shutdown initiated


Exit
```

Next, restart MSM. This time, the start-up sequence will display more information about the various processes that will be automatically started when MSM is restarted.

When MSM is restarted, a number of additional messages should appear. These messages indicate that DDP connections are being constructed.



Login into the manager account by entering "**MGR:XXX**".

3.13.7 Manually define the DDP circuits

An MSM system can be set to one of two modes of operation:

- Only use DDP circuits that are manually defined.
- Use any DDP circuits that can be automatically detected on the local network.

The latter mode of operation is a convenient method of gathering parameters about systems that are locally available, the former guarantees that the MSM system will only connect to those systems that are registered in its configuration. When a site adds a significant number of systems that support DDP, the automatic detection mechanism may reach its license limit before the **V*IST*A** system is detected, and thus not be able to "see" the **V*IST*A** system. Therefore, it is sometimes recommended to use "manual" definitions of DDP circuits.

Note: If the network interface of the main **V*IST*A** HIS computer or the primary mount point changes, the manual circuit value(s) entered here must be updated accordingly to the new MAC address(s). This is a common cause of DDP network failure after a main HIS upgrade.

Manual definition of DDP circuits can be accomplished through the following series of commands:

```
[MGR,IMA]>Do ^SYSGEN <Enter>

          MSM - System Generation Utility

Select SYSGEN Option:

    1 - Display Configuration Parameters
    2 - Create New Configuration
    3 - Edit Configuration Parameters
    4 - Edit Configuration Name/Comment
    5 - Delete Configuration
    6 - Set Default Startup Configuration
    7 - UCI Management
    9 - System Configuration Parameters
   10 - Database Definition
   12 - Device Translation Tables
   13 - Mnemonic Namespaces
   14 - Journaling Management

Select Option: 3 <Enter> - Edit Configuration Parameters

Select Configuration <DICOM>: <Enter> DICOM

Select SYSGEN Option:

    1 - SYSGEN (step through full SYSGEN)
. . .
   15 - Network Configuration

. . .
   20 - Mode Flags

Select Option: 15 <Enter> - Network Configuration


Available Functions:

    1 - DDP System Parameters
. . .
    3 - Circuit Definition
. . .
   15 - PDQWeb Service Configuration
```

```
Select Option: 3 <Enter> - Circuit Definition

Current Circuits Defined:

Circuit  Link  Volume Groups    Remote System      Mode   Timeout  Defn
-------  ----  ---------------  -----------------  -----  -------  -----
  SAF      1   SAF,ROU,VAA,VBB  00-80-C7-47-BF-A3  DSMV2    16     Auto
               VCC
  DSD      1   ROU,VAA          AA-00-04-00-AA-0A  DSMV2    16     Auto
  CSA      1   CSA,MIR          00-00-1D-03-69-B2  MSMV3    16     Auto
```

Note: The identity of the DDP connection for the "live" VistA system depends on the site. Usually, there is only one connection that includes "Volume Groups" with names like "ROU", "VAA", "VBB", and so forth. When a site also runs one or more test systems that use similar names, consult with the VistA site manager to find out which "Circuit" is the one to be used.

```
Select Circuit: DSD <Enter>

Communications Mode:

     1 - Micronetics Standard MUMPS (MSM or MUMPS/VM)
     2 - Digital Standard MUMPS (DSM)
     3 - Open MUMPS Interconnect (OMI)
     4 - Intersystem Standard MUMPS (ISM), VAX
     5 - Intersystem Standard MUMPS (ISM), PDP11
     6 - MSM Version 2 or Version 3 (MSMV2)

Select Communications Mode <1>: 2 <Enter>

DDP Link Number <1>: 1 <Enter>

Mounted Volume Groups <DSD>: ROU,VAA <Enter>

Ethernet Physical Address: xx-xx-xx-xx-xx-xx <Enter> [ Copy the address from
above ]

Network Response Timeout <16>: 300 <Enter>

Save this node into the database<Y/N>: Y <Enter>

Node DSD saved

Current Circuits Defined:


Circuit  Link  Volume Groups    Remote System      Mode   Timeout  Defn
-------  ----  ---------------  -----------------  -----  -------  -----
  DSD      1   ROU,VAA          xx-xx-xx-xx-xx-xx  DSMV2   300     Man

Select Circuit: <Enter>

Available Functions:

    1 - DDP System Parameters
. . .
   15 - PDQWeb Service Configuration

Select Option: <Enter>
```

```
Select SYSGEN Option:

    1 - SYSGEN (step through full SYSGEN)
. . .
   20 - Mode Flags

Select Option: <Enter>

Select SYSGEN Option:

    1 - Display Configuration Parameters
. . .
   14 - Journaling Management

Select Option: <Enter>
```

[MGR,IMA]>

3.13.8 Disable automatic network configuration

This step can be accomplished through the following series of commands:

```
[MGR,IMA]>Do ^SYSGEN <Enter>

          MSM - System Generation Utility

Select SYSGEN Option:

    1 - Display Configuration Parameters
. . .
    3 - Edit Configuration Parameters
. . .
   14 - Journaling Management

Select Option: 3 <Enter> - Edit Configuration Parameters

Select Configuration <DICOM>: <Enter> DICOM

Select SYSGEN Option:

    1 - SYSGEN (step through full SYSGEN)
. . .
   15 - Network Configuration
. . .
   20 - Mode Flags

Select Option: 15 <Enter> - Network Configuration

Available Functions:

    1 - DDP System Parameters
. . .
   15 - PDQWeb Service Configuration

Select Option: 1 <Enter> - DDP System Parameters

Number of DDP Buffers <200>: <Enter> 200

Maximum Number of DDP Circuits <20>: <Enter> 20
```

```
Number of DDP Servers <2>: <Enter> 2

Number of Seconds to Wait for Network Response <16>: 300 <Enter>

Job Number Base for This System <0>: <Enter> 0

Automatic Network Configuration <Y>: N <Enter>  [This setting is changed ]

Display DDP Messages <Y>: <Enter> Y

Available Functions:

    1 - DDP System Parameters
. . .
   15 - PDQWeb Service Configuration

Select Option: <Enter>


Select SYSGEN Option:

    1 - SYSGEN (step through full SYSGEN)
. . .
   20 - Mode Flags

Select Option: <Enter>

Select SYSGEN Option:

    1 - Display Configuration Parameters
. . .
   14 - Journaling Management

Select Option: <Enter>
[MGR,IMA]>
```

3.14 Initial Installation and Update

The following steps are performed both for an initial installation and an update.

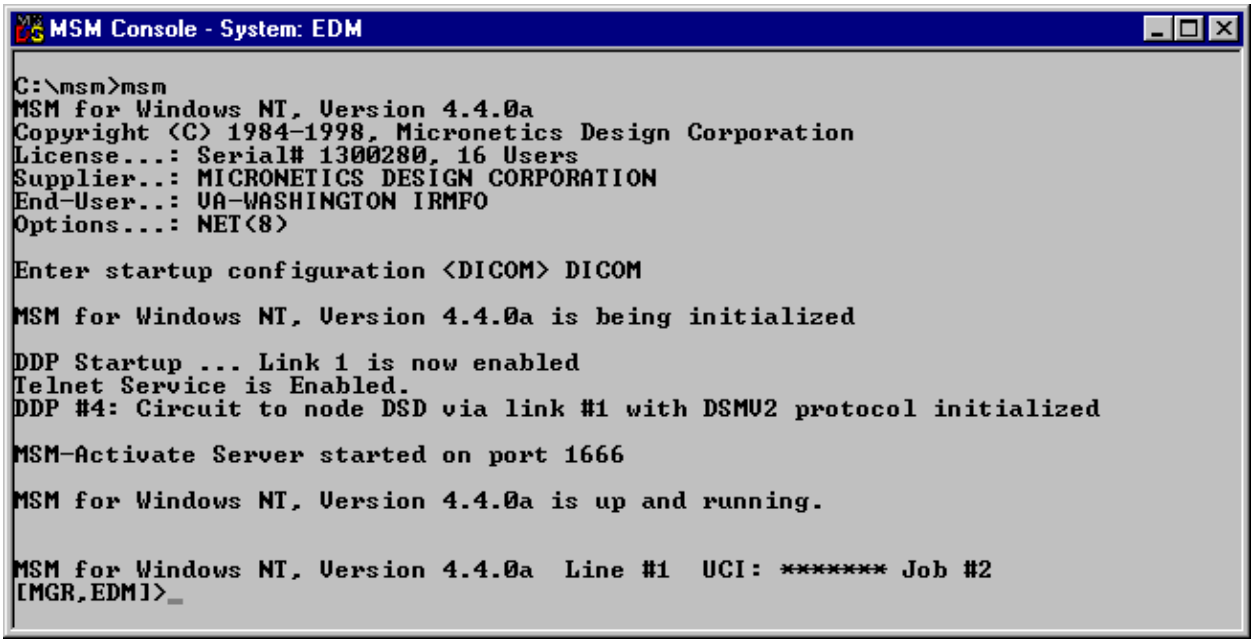
3.14.1 Restart MSM

When all "manual" links are defined, shut down the MSM Server, and restart it.

```
>Do ^SSD <Enter>


          MSM - System Shutdown


Ok to proceed <N>? Y <Enter>

Shutdown initiated
```

```
Exit
```

When MSM is restarted, the only DDP connections that will be established will be those that have been defined as "manual".



3.14.2 Establish Translation Tables

A translation table is a specification that tells the MSM system where to look for instances of global variables. For proper operation of the VistA Imaging DICOM Gateway, the following instances of global variables should be used:

Sequence	Name(s)	Location
1	^MAGDICOM	DCM,DCM (local DICOM Gateway Workstation)
2	^MAGDINPT	DCM,DCM (local DICOM Gateway Workstation)
3	^MAGDMLOG	DCM,DCM (local DICOM Gateway Workstation)
4	^MAGDWLST	DCM,DCM (local DICOM Gateway Workstation)
5	^MAG*	Site's VistA Hospital Information System
6	^DD	Site's VistA Hospital Information System
7	^DG*	Site's VistA Hospital Information System

Sequence	Name(s)	Location
8	^DI	Site's **V*IST*A** Hospital Information System
9	^DIAR	Site's **V*IST*A** Hospital Information System
10	^DIC	Site's **V*IST*A** Hospital Information System
11	^DPT	Site's **V*IST*A** Hospital Information System
12	^HOLIDAY	Site's **V*IST*A** Hospital Information System
13	^LR	Site's **V*IST*A** Hospital Information System
14	^MCAR	Site's **V*IST*A** Hospital Information System
15	^RA*	Site's **V*IST*A** Hospital Information System
16	^SC	Site's **V*IST*A** Hospital Information System
17	^SRF	Site's **V*IST*A** Hospital Information System
18	^VA*	Site's **V*IST*A** Hospital Information System
19	^XMB	Site's **V*IST*A** Hospital Information System
20	^%ZOSF*	MGR,DCM (DICOM Database)
21	^%*	MGR,IMx (MSM Distribution Database)

For the global variables **^MAGDICOM**, **^MAGDINPT**, **^MAGDWLST**, and **^MAGDMLOG**, the parameters are already entered in the distributed copy of the MSM system.

The system looks for the other global variables on the master **V*IST*A** system. The name of the appropriate volume group and UCI can be found by trying the various names of volume groups that are visible in the "defined circuits" window (see 3.18.4). In this sample environment, these volume groups are "ROU" and "VAA". In **V*IST*A**, the hospital information is stored in the UCI called "VAH".

Note: The various global variables may be stored in any number of volume sets (DSM) or volume groups (MSM) in the **V*IST*A** system.

In order to populate the "translation table" with the correct values, run the program MGR^ZMAGDGFN.

```
[MGR,IMA]> Do MGR^ZMAGDGFN <Enter>
```

```
[MGR,IMA]>
```

Next, activate the "translations" through the program ^TRANSLAT.

```
[MGR,IMA]>Do ^TRANSLAT <Enter>

          MSM - Translation/Replication Management Utility

Available Functions:

    1 - Edit Translation Table
    2 - Enable Translation
    3 - Disable Translation
    4 - Edit Replication Table
    5 - Translation Table List
    6 - Replication Table List

Select Option: 3 <Enter> - Disable Translation

Are you sure? <NO>: YES <Enter>   done

Press <RETURN> to continue

Available Functions:

    1 - Edit Translation Table
    2 - Enable Translation
    3 - Disable Translation
    4 - Edit Replication Table
    5 - Translation Table List
    6 - Replication Table List

Select Option: 2 <Enter> - Enable Translation

Enabling translation...

Press <RETURN> to continue <Enter>

Available Functions:

    1 - Edit Translation Table
. .
    6 - Replication Table List

Select Option: <Enter>
[MGR,IMA]>
```

3.14.3 Copying Radiology and MAS Software from Main HIS to Gateway

The VistA Imaging DICOM Gateway uses a number of routines that belong to other applications, such as Radiology, MAS and Kernel that run on the main VistA Hospital Information System. When patches are applied to these routines on the main VistA system, these routines need to be copied to the VistA Imaging DICOM Gateway computers as well.

The purpose of this menu option is to automatically copy the routines for these applications from the main VistA HIS to the Gateways. Transfer of patched routines occurs in two steps:

1. On the **V*IST*A** HIS side, a menu option needs to be run to copy the current versions of the routines into temporary storage.

2. On each **V*IST*A** Imaging DICOM Gateway, a menu option needs to be run to load the routines from this temporary storage.

Step 1: Copy routines to Temporary Storage

On the **V*IST*A** Hospital Information System, execute the menu option "**Copy Routines to DICOM Gateway**" from the Imaging System Manager menu. (This menu option requires the "MAG SYSTEM" security key).

```
Select Imaging System Manager Menu Option: ?

   DS     Define Imaging Site Parameters
   IW     Edit Image WRITE LOCATION only.
   WF     Enter/Edit Background Processor Workstation File
   NT     Enter/Edit Network Location
   LS     Edit Network Location STATUS
   PUR    Edit Imaging Purge Parameters
          Copy Routines to DICOM Gateway
          VISTA Rad System Options ...

Select Imaging System Manager Menu Option:
            COP <Enter> y Routines to DICOM Gateway

Now copying:

RARIC            78 lines
RARTE2          117 lines
. . .
XUSRB1           65 lines
```

Remember to run the appropriate option on the DICOM Gateway!

Step 2: Re-load the Routines from Temporary Storage

On each **V*IST*A** Imaging DICOM Gateway, execute the menu option that re-loads the routines that were saved on the **V*IST*A** HIS.

→ **4** System Maintenance

→ → **2** Gateway Configuration and DICOM Master Files

→ → → **9** Download Current Radiology and MAS Routines

```
RARIC            78 lines
RARTE2          117 lines
. . .
XUSRB1           65 lines
```

3.15 End of First Phase of Installation

At this point, the express set-up of the software is complete.

Continue with Chapter 4, which explains the definition of a number of site-specific parameters.

Chapter 4 Site-Specific Set-Up

This chapter describes how to build the Master File Dictionaries for the DICOM applications.

All of the examples in this chapter assume that the master files are stored in the **\DICOM\Dict** directory on an NT file server that is mounted as a networked drive and accessed using the letter **F:**.

The format and content of the master files is described in Appendix B.

4.1 Site-Specific parameters

The master files contain dictionary and configuration information that is used by the DICOM applications. Those master files that contain static dictionary information should not be modified (e.g. the DICOM Element Dictionary). Files containing site-specification configuration information must be customized before proceeding (e.g. list of instruments present at a site).

The master files are located in the directory **F:\DICOM\Dict**. (If in section 3.8 a different drive letter was chosen, use that drive letter throughout this chapter.) The local modifications to be made to these files are described in Appendix B. The files to be modified are:

- Instrument.DIC (see Appendix B.4.1)
- Modality.DIC (see Appendix B.4.2)
- Portlist.DIC (see Appendix B.4.3)
- SCU_list.DIC (see Appendix B.4.4)
- Worklist.DIC (see Appendix B.4.5)

4.2 Local Modifications

The contents of the master files **Instrument.DIC**, **Modality.DIC**, **PortList.DIC**, **Worklist.DIC** and **SCU_List.DIC** need to be modified to reflect the equipment that is present at the site. See Appendix B for details on the contents of these files.

Make any modifications that are needed to these files, and then continue with the steps below.

4.3 Configure the DICOM Gateway and load the DICOM Dictionaries

The following subsections describe the process of completely configuring a **V*IST*A** Imaging DICOM Gateway including loading of all the dictionaries.

Note: Individual portions of the **V*IST*A** Imaging DICOM Gateway can be selectively updated as well. This operation is described in the **V*IST*A** Imaging DICOM Gateway User Manual.

Log into the application environment:

```
MSM for Windows NT, Version 4.4.0a  Line #1  UCI: DCM:XXX <Enter>  Job #4
```

Use the menu to start the program:

```
[DCM,DCM]>Do ^MAGDMENU <Enter>
```

4 System Maintenance

→ **2** Gateway Configuration and DICOM Master Files

→ → **8** Reinitialize All the DICOM Master Files

```
Ready to build all of the DICOM Master Files?  y//  <Enter> yes
```

4.3.1 Name of System

The system title is a short character string that appears on the top of the main DICOM application menu. Examples:

"Moscow DICOM Image Server System #3"

"Istanbul DICOM Text Gateway and Background Processor"

```
Please enter the system title: Ed's Workstation <Enter>
```

4.3.2 DICOM Data Directories

The DICOM data directories are located on the local system, and are used to hold both the DICOM text and image files. D:\DICOM is typically the DICOM data directory. You may select another device letter (C:-Z:), however.

```
Please enter the device letter for
the DICOM text directory: d:// d <Enter>
```

```
Please enter the device letter for

the DICOM image directories: d:// d <Enter>
```

4.3.3 Percentage of Free Disk Space

The software will cease storing image files when the amount of free disk space drops below a certain threshold. The usual value for this threshold is **15%**.

```
Please enter the percentage of free disk space
required to allow storage of image files: 15%// 15 <Enter>
```

4.3.4 DICOM Dictionary Directory

The DICOM dictionary directory is usually on a networked system, and is used to hold DICOM master files. F:\DICOM is typically the DICOM dictionary directory. You may select any other device letter, however.

```
Enter the device letter for

the DICOM dictionary directory: c:// f <Enter>
```

4.3.5 Communication Channels

Communication channels are used to broadcast **V*IST*A** event data. A separate channel is needed for each different destination. For instance, event data may be sent to both a commercial PACS and to one or more Modality Worklist service class providers (for example a Mitra Broker or a DeJarnette MediShare). Each destination must have its own event channel ***n*** and a dedicated c:\dicom\data***n*** subdirectory.

The number of communication channels must be between 1 and 9.

```
Please enter the number of communication channels  2// 2 <Enter>
```

4.3.6 Machine ID

Each computer that is used as a Text or Image DICOM Gateway needs a single unique identification letter. Use "**A**" for the first Image Gateway, "**B**" for the second Image Gateway, "**C**" for the third Image Gateway, and so forth, and "**Z**" for the Text Gateway. The names of the DICOM image files acquired by this system will begin with this letter.

Please enter the machine ID: **A <Enter>**

4.3.7 DICOM Image Gateway

If this system is to be configured as a **V*IST*A** DICOM Image Gateway, the answer to this question must be "**Yes**". If this system is to be configured otherwise, answer "**No**".

Note: A **V*IST*A** DICOM Gateway may be configured as a Text Gateway, as an Image Gateway, or as both.

```
Will this system be a DICOM Image Gateway?  YES// y <Enter>
```

4.3.8 DICOM Text Gateway

If this system is to be configured as a **V*IST*A** DICOM Text Gateway, to support the Modality Worklist and/or send event messages to a commercial **P**icture **A**rchiving and **C**ommunication **S**ystem (PACS), the answer to this question must be "**Yes**". If this system is to be configured otherwise, answer "**No**".

Note: A **V*IST*A** DICOM Gateway may be configured as a Text Gateway, as an Image Gateway, or as both.

```
Will this system be a DICOM Text Gateway?  YES// y <Enter>
```

4.3.9 Send Text to commercial PACS

If this **V*IST*A** DICOM Text Gateway is to be configured to send messages to either a commercial PACS or a Modality Worklist provider (for example, a Mitra Broker or a DeJarnette MediShare), the following question should be answered with "**Yes**". Otherwise answer "**No**".

```
Send text to a commercial PACS, Mitra Broker, et cetera? n// n <Enter>
```

4.3.10 Receive EXAM COMPLETE Message from commercial PACS

The EXAM COMPLETE message is sent by some commercial PACS to signal that all the images for a study have been acquired and are ready to be sent to **V*IST*A**. The EXAM COMPLETE message then serves as a trigger for **V*IST*A** to pull the images from the commercial PACS. Other commercial PACS do not use the EXAM COMPLETE message, but autoroute their images to **V*IST*A**.

If a commercial PACS is going to transmit EXAM COMPLETE messages to **V*IST*A** that indicate all the images in a study are ready to be sent, answer "**Yes**" to this question, otherwise answer "**No**".

```
Is a PACS going to send Exam Complete messages to VistA?  NO// n <Enter>
```

4.3.11 Kind of PACS

If the previous question is answered with "Yes", an additional question will be asked:

```
Select the kind of commercial PACS at this site
-----------------------------------------------
    1 - GE Medical Systems PACS with Mitra PACS Broker
    2 - GE Medical Systems PACS with ACR-NEMA Text Gateway
    3 - eMed Technology Corporation PACS
    4 - Other commercial PACS

What kind of a PACS?
```

Enter the sequence number for the kind of PACS that is present at the site.

4.3.12 Modality Worklist Provider

If this Text Gateway is to be configured to provide the "Modality Worklist" capability, answer "**Yes**" to this question, otherwise, answer "**No**".

```
Will this system be a Modality Worklist Provider?  y// <Enter> yes
```

4.3.13 Send CPT Modifiers

With Radiology Package patch RA*5*10, modifier codes are included when CPT codes are transmitted. These modifier codes may be sent to PACSs and modalities via DICOM as a two-character suffix to a procedure code (*nnnn-xx*). The usual configuration is to include the modifier suffix.

If the modifier suffices are to be included in messages, answer "**Yes**" to this question, if these suffixes are to be omitted, answer "**No**".

If the site is going to use **V*IST*A** RAD, then select "Yes". If it is going to use a commercial PACS, check with the vendor to see if it can support CPT-Modifiers.

```
Send CPT Modifiers? Yes // <Enter> Yes
```

4.4 Loading the DICOM Dictionaries

The DICOM Dictionaries are constructed by populating a number of Fileman globals with data from the master files. Appendix B contains a detailed description of each master file. The format and contents of the resulting subtrees in global variable ^MAGDICOM(2006.5xx) are described in the (on-line) FileMan Data Dictionaries.

Sites should only make changes to the master files for the site-specific DICOM Dictionaries. The information in the global variable themselves should not be manually modified, as it will be overwritten the next time the master file is loaded.

4.4.1 DICOM Data Element Dictionary

During this step, the contents of the file **ELEMENT.DIC** are loaded into global variable **^MAGDICOM(2006.51,…)**.

The contents of the master file **ELEMENT.DIC** may not be modified by the site.

```
Building the DICOM Element Dictionary -- ^MAGDICOM(2006.51)
Ready to read dictionary file "f:\DICOM\Dict\ELEMENT.DIC"?  y// y <Enter>
```

4.4.2 DICOM Message Template Dictionary

During this step, the contents of the file **TEMPLATE.DIC** are loaded into global variable **^MAGDICOM(2006.52,…)**.

The contents of the master file **TEMPLATE.DIC** may not be modified by the site.

```
Building the DICOM Message Template Dictionary -- ^MAGDICOM(2006.52)
Ready to read dictionary file "d:\DICOM\Dict\TEMPLATE.DIC"?  y// <Enter> yes

*** PASS 1 STARTED ***
*** PASS 2 STARTED ***
- DONE -
```

4.4.3 DICOM Unique Identifier Dictionary

During this step, the contents of the file **UID.DIC** are into global variable **^MAGDICOM(2006.53,…)**.

The contents of the master file **UID.DIC** may not be modified by the site.

```
Building the DICOM UID Dictionary -- ^MAGDICOM(2006.53)
Ready to read dictionary file "f:\DICOM\Dict\UID.DIC"?  y// y <Enter>
```

4.4.4 Extended SOP Negotiation Table

During this step, the Extended SOP (Service Object Pair) Negotiation Table is loaded into global variable **^MAGDICOM(2006.531,…)**.

```
Updating the extended SOP negotiation table... done!
```

4.4.5 DICOM PDU Types

During this step, the PDU (Protocol Data Unit) table is loaded into global variable **^MAGDICOM(2006.54,…)**.

```
Updating the PDU TYPE table... done!
```

4.4.6 Imaging Service Dictionary

During this step, the Imaging Service Dictionary is loaded into global variable **^MAGDICOM(2006.589,…)**.

```
Updating the Imaging Service table...

done!
```

4.4.7 DICOM HL7 Segment and Field Dictionary

During this step, the contents of the file **HL7.DIC** are loaded into global variable **^MAGDICOM(2006.57,…)**.

The site may not modify the contents of the master file **HL7.DIC**.

```
Building the DICOM HL7 dictionary in ^MAGDICOM(2006.57)
Ready to read dictionary file "f:\DICOM\Dict\HL7.dic"?  y// y <Enter>

done!
```

4.4.8 Instruments

During this step, the contents of the file **INSTRUMENT.DIC** are loaded into global variable **^MAGDICOM(2006.581,…)**.

The contents of the master file **INSTRUMENT.DIC** must be customized for the site.

```
Building the Instrument Dictionary -- ^MAGDICOM(2006.581)
Ready to read dictionary file "f:\DICOM\Dict\INSTRUMENT.DIC"?  y// y <Enter>
```

4.4.9 Modalities

During this step, the contents of the file **MODALITY.DIC** are loaded into global variable **^MAGDICOM(2006.582,…)**.

The contents of the master file **MODALITY.DIC** must be customized for the site.

```
Building the Modality Type Dictionary -- ^MAGDICOM(2006.582)
Ready to read dictionary file "f:\DICOM\Dict\MODALITY.DIC"?  y// y <Enter>
```

4.4.10 Modality Worklist

During this step, the contents of the file **WORKLIST.DIC** are loaded into global variable **^MAGDICOM(2006.583,…)**.

The contents of the master file **WORKLIST.DIC** must be customized for the site.

```
Building the Modality Worklist Dictionary -- ^MAGDICOM(2006.583)
Ready to read dictionary file "f:\DICOM\Dict\WORKLIST.DIC"?  y// y <Enter>
```

4.4.11 Port Numbers for Text Gateway sending messages to PACS

During this step, the contents of the file **PORTLIST.DIC** are loaded into global variable **^MAGDICOM(2006.584,…)**.

The contents of the master file **PORTLIST.DIC** must be customized for the site.

Note: There may be no entities in the file.

```
Building the TCP/IP Provider Port Dictionary -- ^MAGDICOM(2006.584)
Ready to read dictionary file "f:\DICOM\Dict\PORTLIST.DIC"?  y// y <Enter>
```

4.4.12 User Application Parameters

During this step, the contents of the file **SCU_LIST.DIC** are loaded into global variable **^MAGDICOM(2006.585,…)**.

The contents of the master file **SCU_LIST.DIC** must be customized for the site.

```
Building the User Application Dictionary -- ^MAGDICOM(2006.585)
Ready to read dictionary file "f:\DICOM\Dict\SCU_LIST.DIC"?  y// y <Enter>
```

4.4.13 Provider Application Dictionary

During this step, the contents of the file **SCP_LIST.DIC** are loaded into global variable **^MAGDICOM(2006.586,…)**.

The contents of the master file **SCP_LIST.DIC** may not be modified by the site.

```
Building the Provider Application Dictionary -- ^MAGDICOM(2006.586)
Ready to read dictionary file "f:\DICOM\Dict\SCP_LIST.DIC"?  y// y <Enter>
```

4.4.14 Data Transfer

The master file named **Modality.DIC** references several other dictionary files that contain lists of additional data elements to be displayed on a diagnostic workstation. These “data transfer” dictionaries are loaded during this step.

```
Ready to build the "Data Transfer" Dictionaries?  y// y <Enter>

-- DICOM Master File Build completed successfully --
```

4.5 Automatically Generating Instrument Shortcut Icons

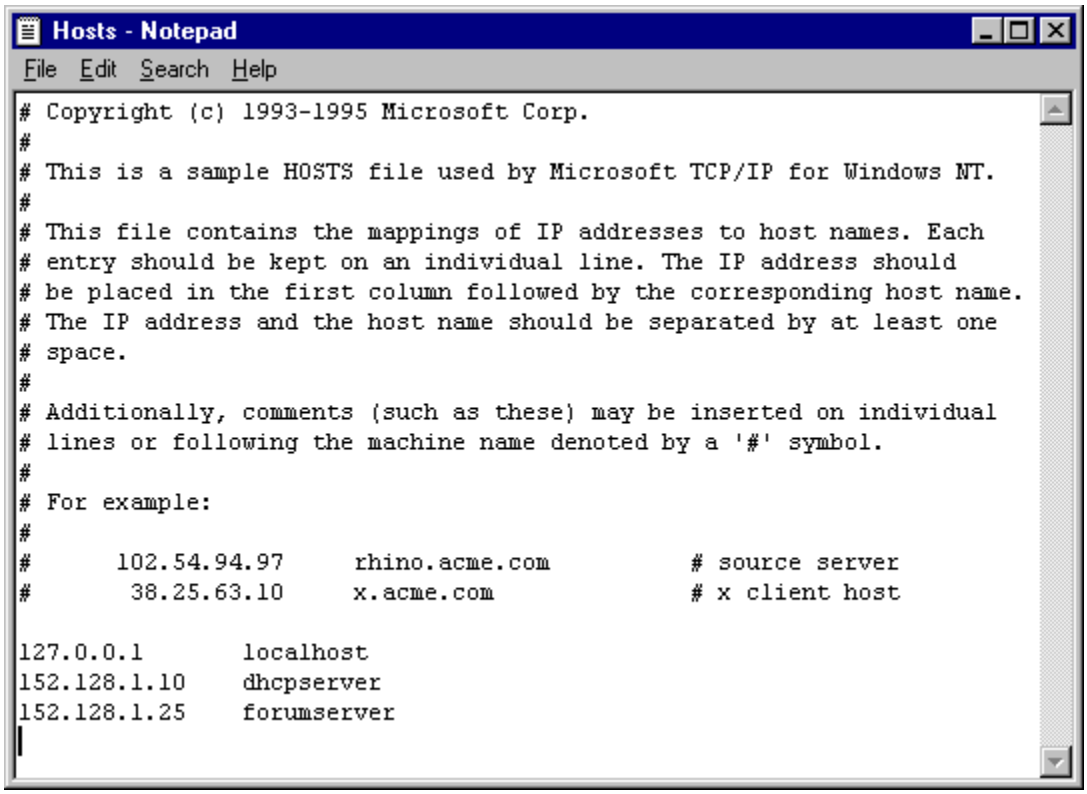
The program ^MAGDMFIC can be run to generate the instrument shortcut icons.

```
[DCM,DCM]>d ^MAGDMFIC <Enter>
```

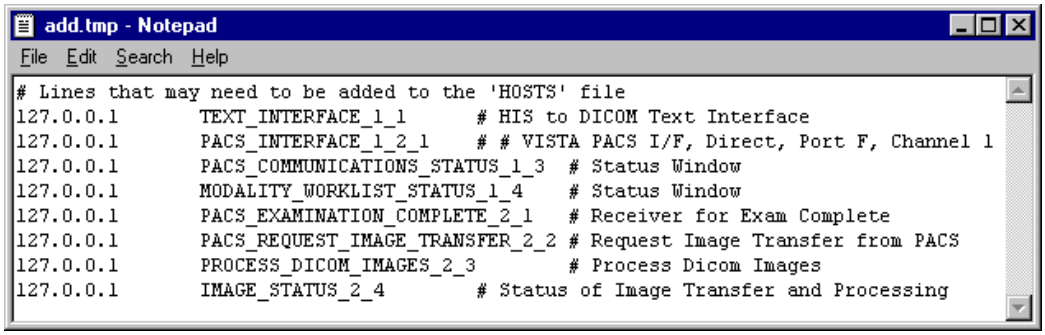
```
Do you want to edit the 'HOSTS' file? Y// <Enter>
Done.

[DCM,DCM]>
```

The program first builds all "shortcuts" (in sub-directories of x:\DICOM\Icons\…) and then offers the installer the option to add a number of definitions to the "hosts" file. This file defines the "aliases" for the various TCP/IP addresses that may be needed for communication between the various pieces of equipment.

The program will open two Notepad™ windows, one for the file called "Hosts" and one for the file called "add.tmp". These are shown on the next two figures.



HOSTS



ADD.TMP

The user performing the installation can cut and paste lines with definitions from the window labeled “add.tmp” to the window labeled “hosts”. When done editing, first close the window labeled “hosts” and then close the window labeled “add.tmp”.

4.6 Adding DICOM Application Entities to the HOSTS file

When a DICOM Application Entity connects to a **V*IST*A** Imaging DICOM Gateway, the gateway attempts to determine the network identity (i.e., the IP address) that is making the connection. It does this by invoking the operating system function `gethostbyaddr()`. This works most effeciently when the IP address of the instrument is registered in the **V*IST*A** Imaging DICOM Gateway’s “**HOSTS**” file. (The full name of this file is typically **c:\WinNT\System32\Drivers\etc\hosts**.)

Each DICOM Application Entity needs to be added to the hosts file so that the gateway can quickly resolve names when TCP/IP connections are created. For each instrument (and each separate Modality Worklist service class user), add the IP address and mnemonic to the “**HOSTS**” file.

The following is an example from of a “HOSTS” file.

```
127.0.0.1       localhost

111.222.333.40    GECT1                         # GE High Speed CTI, Room F24
111.222.333.41    GEADW                         # GE Advantage Workstation F24
111.222.333.42    GEMR                          # GE Signa MRI, Room Mobile Trailer
```

#End of File

Details on this are given below in Section 0.

4.7 M Security – Programmer Access Code and Tied Terminal Table

As a final step, access to the MSM login prompt will be restricted by making all access through telnet lines tied to the **V*IST*A** DICOM login program.

Note 1: In the sample text below, the text "**password**" appears several times. For each instance, use a site-specific password that is appropriate. Passwords must be six or more characters in length and must consist of a combination of letters and numbers. Passwords are case-insensitive, however.

Note 2: When an end-user logs on using the password for "**Print/View Only**", the only menu options that will be available are those that cannot modify the database.

Note 3: Use different passwords for ACCESS code, VERIFY code, PROGRAMMER ACCESS code, PRINT/VIEW ONLY code and SUPPORT code.

```
[DCM,DCM]>Do INIT^MAGDLOGN <Enter>


Enter new ACCESS code: password <Enter>
Re-enter ACCESS code (to make sure I got it right): password <Enter>

Enter new VERIFY code: password <Enter>
Re-enter VERIFY code (to make sure I got it right): password <Enter>

Enter new PROGRAMMER ACCESS code: password <Enter>
Re-enter PROGRAMMER ACCESS code (to make sure I got it right): password
<Enter>

Enter new PRINT/VIEW ONLY code: password <Enter>
Re-enter PRINT/VIEW ONLY code (to make sure I got it right): password <Enter>
```

```
Enter new SUPPORT code: password <Enter>
Re-enter SUPPORT code (to make sure I got it right): password <Enter>
[DCM,DCM]>

[DCM,DCM]>Do ^%LOGON <Enter>

MSM for Windows NT, Version 4.4.0a  Line #3  UCI: MGR:XXX <Enter> Job #11
[MGR,IMA]>Do ^SYSGEN <Enter>

          MSM - System Generation Utility

Select SYSGEN Option:

    1 - Display Configuration Parameters
    2 - Create New Configuration
    3 - Edit Configuration Parameters
    4 - Edit Configuration Name/Comment
    5 - Delete Configuration
    6 - Set Default Startup Configuration
    7 - UCI Management
    9 - System Configuration Parameters
   10 - Database Definition
   12 - Device Translation Tables
   13 - Mnemonic Namespaces
   14 - Journaling Management

Select Option: 3 <Enter> - Edit Configuration Parameters

Select Configuration <DICOM>: <Enter> DICOM
```

```
Select SYSGEN Option:


    1 - SYSGEN (step through full SYSGEN)
    2 - Backspace, Line Delete Character
    3 - Autostarts and Automounts
    4 - Maximum Partitions
    5 - Security
    6 - Tuning Parameters
    8 - Tied Terminal Table
    9 - Port (Terminal) Definition
   11 - External Calls Configuration
   12 - Default Partition Size
   13 - Translation/Replication Table Maintenance
   15 - Network Configuration
   16 - Tape Device Definition
   17 - Global Defaults
   18 - LOCK Table Size
   19 - Display Configuration Parameters
   20 - Mode Flags

Select Option: 8 <Enter> - Tied Terminal Table

Enter Tied Terminal Index: 1 <Enter>
Enter Routine Reference: ENTRY^MAGDLOGN <Enter>
Select UCI: DCM,DCM <Enter>
Enter Partition Size for ENTRY^MAGDLOGN <64>: <Enter>

Do you wish to tie any ports to this entry <N>: Y <Enter>
```

```
Enter Port Number, or L (Dynamic LAT ports), or D (other Dynamic Ports): D
<Enter>


Dynamic ports are now tied

Enter Port Number, or L (Dynamic LAT ports), or D (other Dynamic Ports):
<Enter>


Current Tied Terminal Table List:


Index   Routine Reference   UCI,VGP   Partition Size   Ports Tied To Routine

-----   -----------------   -------   --------------   ---------------------

  1     ENTRY^MAGDLOGN      DCM,DCM         64


Non-LAT dynamic ports are tied to index 1


Enter Tied Terminal Index: <Enter>



Select SYSGEN Option:


    1 - SYSGEN (step through full SYSGEN)

. . .

   20 - Mode Flags


Select Option: <Enter>


Select SYSGEN Option:


    1 - Display Configuration Parameters

. . .
```

```
   14 - Journaling Management


Select Option: <Enter>

[MGR,IMA]>
```

4.8 Personal Preferences

Once the above setup procedures are completed, a few more steps may be taken to cosmetically adjust the appearance of the **V*IST*A** Imaging DICOM Gateways.

Since the **V*IST*A** Imaging DICOM Gateway software uses a lot of windows that will be simultaneously open, screen real estate on the monitor is at a premium. The current minimum resolution is 1280 by 1024 pixels, and, sometimes, that is still not enough. As a result, it is recommended to turn off all "frills" on directory windows: turn off all toolbars, all status bars, and don't use "web-view". (All of these are by themselves interesting additions, but for the purpose of a DICOM Gateway, they just take up a lot of display space, and don't offer any value in return.) Do leave the task bar that is usually at the bottom of the screen, however.

Note: Any customizations described in this section should be repeated for each **V*IST*A** Imaging DICOM Gateway, so that all stations will present a similar appearance.

In order to make the final adjustments to the desktop, login with the user name that will be used to login into **V*IST*A** from the current workstation (it is recommended that this name be **VHAvv\VHAxxxIU**).

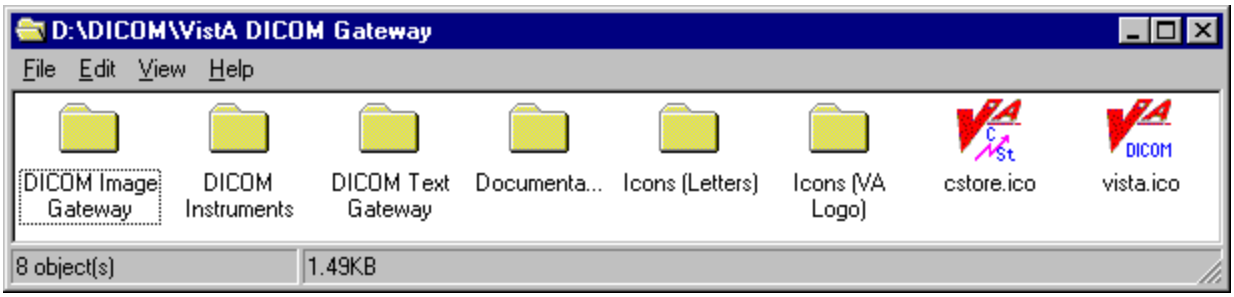
Remove any icons that are left over from installation procedures, e.g. *Install IE 4.01*, *Install Service Pack 3*, from all profiles (including the profile called "All Users").

At this point, all software and data is installed on the PC. This chapter describes a number of procedures that may be performed to validate that the installation software is correct and complete.

The installation should have created a new icon on the desktop:

Please refer to Appendix A for detail instuction for defining shortcuts.

Double-click on this icon to view a number of further folders with icons that belong to the **V*IST*A** Imaging DICOM Gateway:

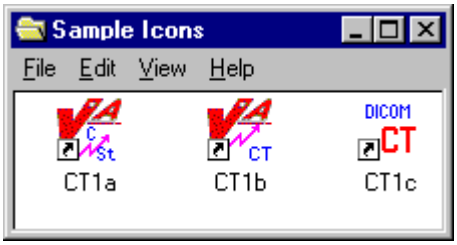


Depending on the purpose of the gateway, one or more of these folders will be used for the day-to-day operation. See the **V*IST*A** Imaging DICOM Gateway User Manual for further details on these icons and folders.

The installation procedure has created a folder named **\DICOM\Icons\Instruments** on the "data disk" This folder is easily accessible through the "VA-Logo" icon that is placed on the desktop. Some sites prefer to have the instruments separated out into multiple "folders" by gateway system, so that each folder contains only those instruments that are assigned to a specific gateway. Other sites prefer to turn off the "auto arrange" feature on the directory windows, and manually arrange the icons in the windows so that the selection for a specific machine can be made visible by scrolling and sizing the window.

If a site prefers to separate the folders for the various computers, a fairly straightforward way to achieve this separation is to create subfolders in **\DICOM\Icons\Instruments** that each reflect one of the gateways, e.g. **\DICOM\Icons\Instruments\DIG1** through **\DICOM\Icons\Instruments\DIG4** if there are four image gateways. The icons for the various instruments can then be moved easily into the directories for the assigned gateways.

The icons for the various instruments are initially all the same. The folders **\DICOM\Icons\Icons (Letters)** and **\DICOM\Icons\Icons (VA Logo)** contain additional icons that may be used to designate the various instruments in a more specific manner.



4.9 Recommended Icons

The installation process creates a number of icons for the benefit of the end-user. A typical site will only use a subset of these icons. It is recommended that a site customize the windows that

are described above. Usage of the various icons will depend on the tasks that are run from the system. The table below shows which gateway tasks relate to which icons.

Icon	Text Gateway without PACS	Text Gateway with PACS	Image Gateway without PACS	Image Gateway with PACS	Combined Text and Image Gateway without PACS	Combined Text and Image Gateway with PACS
Command Prompt	X	X	X	X	X	X
MSM Console	X	X	X	X	X	X
MSM Terminal	X	X	X	X	X	X
Text Gateway	X	X			X	X
PACS Interface	X	X			X	X
PACS Communication Status		X				X
Modality Worklist Status	X	X			X	X
Examination Complete				X		X
Request Images				X		X
Process DICOM Images			X	X	X	X
Image Status			X	X	X	X
DICOM Viewer			X	X	X	X

Chapter 5 KIDS Package to Install in the V*IST*A System

This chapter describes the installation of the "KIDS" package that is to be installed into a **V*IST*A** system to support the **V*IST*A** Imaging DICOM Gateway that will be running on satellite PCs. The complete KIDS installion is detailed in the **V*IST*A** Imaging Installation Guide. Specific details pertinent to the DICOM Gateway are covered here.

The name of the KIDS package is "**V*IST*A Imaging**". Review **V*IST*A** Imaging Installation Guide for an example of the KIDS installation.

Installation of the KIDS package "**V*IST*A Imaging**" is required to establish the files needed for DICOM image acquisition and for DICOM text Gateway. It establishes the global variable (^MAGDHL7) used for providing information to an outside PACS vendor and for providing a modality worklist to a radiology instrument. Data dictionaries and menu options are also created to assist in manual correction of images that failed to be processed during the initial image download for the Radiology and Medicine modalities.

The "**V*IST*A Imaging**" KIDS package contains DICOM gateway components as described in the following sections.

5.1 Data Dictionaries

5.1.1 PACS MESSAGES (^MAGDHL7(2006.5,…))

- This file is used to store HL7 messages relating Radiology orders, patient demographics, and admission/discharge and transfer events. The DICOM TEXT GATEWAY uses the information in this file.
- Data for this file will reside on the MSM Image Storage server.

5.1.2 DICOM FAILED IMAGES (^MAGD(2006.575,…))

- This file is used to store information regarding DICOM images, which failed during the downloading. DICOM header variables acquired during the initial image download are stored as well as the filename path reference.
- Data for this file will reside on the MSM Image Storage server.
- This file will be populated and maintained by the MSM Image Storage server.

5.1.3 DICOM UNDEFINED MODALITIES (^MAGD(2006.592,…))

This file is used to store information regarding DICOM images, which do not have an entry defined in the MODALITY.DIC file on the MSM Imaging Storage server. This file will be populated and maintained by the MSM Image Storage server.

5.1.4 DICOM ERROR LOG (^MAGD(2006.599,…))

This file is used to store information regarding DICOM images files that have been deleted, while using the MAGD FIX DICOM FILE or MAGD FIX MEDICINE DICOM FILE menu options, or incomplete DICOM image files.

5.2 Menu Options

5.2.1 MAGD FIX DICOM FILE

This option should be assigned to the Radiology persons who will be correcting the Failed DICOM image files on a daily basis. (Usually the Radiology ADPac.) To correct images acquired from Radiology modalities, CRs, CTs, MRIs, etc.

5.2.2 MAGD FIX MEDICINE DICOM FILE

This option should be assigned to the Medicine person who will be correcting the failed DICOM image files (usually the Medicine ADPac or technician). To correct images acquired from Medicine modalities, OEC C-ARM Fluoro, Olympus Endscopy, etc.

5.3 Protocol Entries

5.3.1 MAGD SEND ORM

This protocol acts as a subscriber for the RA REG, RA CANCEL, RA EXAMINED protocols.

5.3.2 MAGD SEND ORU

This protocol acts as a subscriber for the RA RPT protocol

5.3.3 MAGD DHCP-PACS ADT EVENTS

This protocol acts as a subscriber for the DGPM Movements Events protocol.

5.3.4 HL7 Application Parameter

5.3.4.1 MAGD-CLIENT

This application acts as a subscriber for MAGD protocols.

5.4 Routines

The following listed routines are used for the DICOM component and are included, among other Imaging routines, in the "**V*IST*A Imaging**" KIDS transport. These routines are used in the HL7 message subscribtion protocols and image corrections process.

MAGDHL7	MAGDHL7T	MAGDHLE
MAGDMEDI	MAGDMEDL	MAGDMEDJ
MAGDMED5	MAGGTMC1	MAGDLB1
MAGDLB5	MAGDLB6	MAGDLB7
MAGDLB9	MAGDLBSR	MAGDRA1
MAGDRA2	MAGDRA3	

5.5 V*IST*A -PACS Radiology Interface Setup Instructions:

The following steps are required to establish the global variable (^MAGDHL7) used for providing radiology order information to an outside PACS vendor and for providing a modality worklist to radiology devices. These steps are perfomed on the **V*IST*A** system using Fileman utility. Apply one step at a time, to allow testing changes and tracking errors before apply all changes. It is imperative that you follow the instructions precisely - especially if not in a test account.

5.5.1 Step 1

Use Fileman Enter/Edit to edit file 771 (HL7 APPLICATION PARAMETER) and update the FACILITY NAME field for the following entries RA-CLIENT-IMG, RA-SERVER-IMG and MAGD-CLIENT. Also, ensure that the ACTIVE\INACTIVE field is set to active for entries RA-SERVER-IMG and MAGD-CLIENT

5.5.2 Step 2

Enter the protocol **MAGD SEND ORM** in the SUBSCRIBERS (multiple field) for the protocol **RA REG**.

```
Select OPTION: EN <Enter>TER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS <Enter>
   EDIT WHICH SUBSCRIBERS SUB-FIELD: ALL//
THEN EDIT FIELD:
Select PROTOCOL NAME:  RA REG <Enter>

Select SUBSCRIBERS: MAGD SEND ORM <Enter>  ← Add this item.
```

Note: This protocol is exported in "**V*IST*A Imaging**" KID file.

5.5.3 Step 3

Activate the triggering of HL7 messages during Radiology exam registration by entering RA-SERVER-IMG into the SENDING APPLICATION field of the RA REG protocol entry.

```
Select OPTION: EN <Enter>TER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE: ACCESSION// 101 <Enter>  PROTOCOL    (1710 entries)
EDIT WHICH FIELD: ALL// SENDING APPLICATION <Enter>
THEN EDIT FIELD:

Select PROTOCOL NAME: RA REG <Enter>       Rad/Nuc Med exam registered
SENDING APPLICATION: RA-SERVER-IMG <Enter>
```

Once this step is complete, entries should start populating file 772 and file 2006.5 (global variable ^MAGDHL7). You can test by using the Radiology options to register an exam. For each exam case registered an entry will be set in file 2006.5.

Note: If errors start occurring, remove the **SENDING APPLICATION and SUBSCRIBERS** entries, process for above steps, from the RA REG protocol and contact the National Help Desk. A copy of the error trap should be included when reporting the error. *If an error is encountered do not proceed with the remaining steps until the National Help Desk assists*.

5.5.4 Step 4

Select the **EXAMINATION STATUS** for each Imaging type that should trigger the "examined" HL7 message. The HL7 will only be triggered once for an exam – when the exam has been upgraded to the status with the **GENERATE EXAMINED HL7 MESSAGE** field set to "**yes**". (Examination Status file #72)

Example:

```
>D P^DII <Enter>

VA FileMan 22.0

Select OPTION: ENT <Enter>ER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: PROTOCOL// 72 <Enter>  EXAMINATION STATUS
                                          (55 entries)
EDIT WHICH FIELD: ALL// 8 <Enter>  GENERATE EXAMINED HL7 MESSAGE
THEN EDIT FIELD: <Enter>

Select EXAMINATION STATUS: EXAMINED <Enter>
     1   EXAMINED          GENERAL RADIOLOGY
     2   EXAMINED          ULTRASOUND
     3   EXAMINED          MAGNETIC RESONANCE IMAGING
     4   EXAMINED          NUCLEAR MEDICINE
     5   EXAMINED          CARDIOLOGY STUDIES (NUC MED)
Press <RETURN> to see more, '^' to exit this list, OR
CHOOSE 1-5: 1 <Enter>  EXAMINED        GENERAL RADIOLOGY
GENERATE EXAMINED HL7 MESSAGE: YES// <Enter>
```

5.5.5 Step 5

Follow steps 2-3, and apply to protocol RA EXAMINED instead of RA REG.

```
Select OPTION: EN <Enter>TER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS <Enter>
   EDIT WHICH SUBSCRIBERS SUB-FIELD: ALL//
THEN EDIT FIELD: SENDING APPLICATION <Enter>

Select PROTOCOL NAME:  RA EXAMINED <Enter>
Select SUBSCRIBERS: MAGD SEND ORM <Enter>    <---Add this item. This protocol
                          is exported in VistA Imaging 2.5 kid file).
SENDING APPLICATION:  RA-SERVER-IMG <Enter>
```

Once this step is complete, entries should start populating file 772 and file 2006.5 (MAGDHL7 global). You can test by using the Radiology options to edit an exam. For each exam case edited that is upgraded to the status with the GENERATE EXAMINED HL7 MESSAGE field set to yes, an entry will be set in file 2006.5 (Usually this for all cases that has been upgraded to examined).

Note: If errors start occurring, remove the SENDING APPLICATION and SUBSCRIBERS entries, process for above steps, from the RA EXAMINED protocol and contact the National Help Desk. *If an error is encountered do not proceed with the remaining steps until the National Help Desk assists*.

5.5.6 Step 6

Apply the steps outlined for steps 2-3 for the RA CANCEL protocol.

```
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS <Enter>
   EDIT WHICH SUBSCRIBERS SUB-FIELD: ALL//
THEN EDIT FIELD: SENDING APPLICATION

Select PROTOCOL NAME:  RA CANCEL <Enter>
Select SUBSCRIBERS: MAGD SEND ORM <Enter>    <---Add this item. This protocol
                               is exported in VistA Imaging 2.5 Kid file.
SENDING APPLICATION:  RA-SERVER-IMG <Enter>
```

Use the Radiology option to cancel a radiology case. An entry for each canceled case should be entered into files 772 & 2006.5.

5.5.7 Step 7

Apply step 2 for the **RA RPT** protocol except use the **MAGD SEND ORU** protocol and apply step 3.

```
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS
   EDIT WHICH ITEM SUB-FIELD: ALL//
THEN EDIT FIELD: SENDING APPLICATION <Enter>

Select PROTOCOL NAME:  RA RPT <Enter>
Select SUBSCRIBERS: MAGD SEND ORU <Enter>    <---Add this item. This protocol
                              is exported in Vista Imaging 2.5 KID file.
SENDING APPLICATION:  RA-SERVER-IMG <Enter>
```

Use the Radiology option to produce a verified report. Only verified reports will create entries in files 772 and 2006.5.

Reminder: If any errors occur, the DHCP-PACS Radiology interface can be stopped by…

1. Removing the SENDING APPLICATION and SUBSCRIBERS entries from the protocol causing the error.

2. Removing the MAGD SEND ORM or MAGD SEND ORU from the SUBSCRIBERS field on the protocol causing the error.

3. Send a copy of the error trap to the **National Help Desk**. *If an error is encountered do not proceed with the remaining steps until the National Help Desk assists*.

5.6 V*IST*A -PACS ADT Interface Setup Instructions

Note: Disregard this section if not interfacing to a Commercial PACS system.

The following are the instructions to establish the interface to provide a mechanism for notifying the PACS system regarding changes in ADT events.

5.6.1 Step 1

Use FileMan to set the field PACS INTERFACE SWITCH to ON in the IMAGING SITE PARAMETERS file (#2006.1).

```
Select OPTION: EN <Enter>TER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: IMAGING SITE PARAMETERS// 2006.1 <Enter>
          IMAGING SITE PARAMETER   (1 entry)
```

```
EDIT WHICH FIELD: ALL// PACS INTERFACE SWITCH <Enter>
THEN EDIT FIELD: <Enter>

Select IMAGING SITE PARAMETERS NAME:    your site name <Enter>
PACS INTERFACE SWITCH:   1 <Enter>        ON PACS INTERFACE
```

5.6.2 Step 2

The MAGDHLE routine invokes INIT^HLTRANS which checks for the existence of "PACS GATEWAY" entry in file 770, NON-DHCP APPLICATION PARAMETER.

The HL7 APPLICATION PARAMETER (#771) file needs the following entry established.

```
NAME: PAC GATEWAY
ACTIVE/INACTIVE: ACTIVE
```

In file NON-DHCP APPLICATION PARAMETER (#770) create the following entry.

```
NAME: PACS GATEWAY
NON-DHCP FACILITY NAME:  your facility name
DHCP STATION NUMBER:  your facility number
DHCP APPLICATION: PAC GATEWAY          <<Pointer to file 771.
```

Change the PAC GATEWAY entry in file 771 to PACS GATEWAY.

```
>D Q^DI
VA FileMan 22.0

Select OPTION: ENTER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE: NEW PERSON// 771  HL7 APPLICATION PARAM
                                      (16 entries)
EDIT WHICH FIELD: ALL// .01  NAME
THEN EDIT FIELD:

Select HL7 APPLICATION PARAMETER NAME: PAC GATEWAY          ACTIVE
NAME: PAC GATEWAY// PACS GATEWAY
```

5.6.3 Step 3

The ADT changes are trigged by a protocol running off the MAS Event driver. You must add the MAGD DHCP-PACS ADT EVENTS protocol to the DGPM Movements Events protocol.

```
>D P^DII
VA Fileman 22.0
Select OPTION: ENTER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: IMAGING WORKSTATIONS//  101      PROTOCOL
EDIT WHICH FIELD: ALL// ITEM
     1   ITEM      (multiple)
     2   ITEM TEXT
CHOOSE 1-2: 1
   EDIT WHICH ITEM SUB-FIELD: ALL//
THEN EDIT FIELD:

Select PROTOCOL NAME: DGPM MOVEMENT EVENTS MOVEMENT EVENTS

Select ITEM: IB CATEGORY C BILLING// MAGD DHCP-PACS ADT EVENTS
     NOTIFICATION DHCP-PACS ADT EVENT
  MNEMONIC:       (These fields do not need to be answered.  Just press the
return key on each or "^" to exit.)
  SEQUENCE:
  MODIFYING ACTION:
  FORMAT CODE:
  DISPLAY NAME:
  PROMPT:
  DEFAULT:
  HELP:
  MODE:
Select ITEM:
```

You have completed creating the items necessary for the PACS ADT interface. Use the PIMMS option to Admit, Transfer and Discharge a patient to test the cross-reference setting. During the updating processing, on any of these three transactions, the system will task the cross-reference routine and display the following on the screen, "*** HL7 TASK FOR PACS ***". If successful, the HL7 messages for the events will be recorded in the PACS MESSAGES file (2006.5).

Appendix A Creating “Short-Cuts”

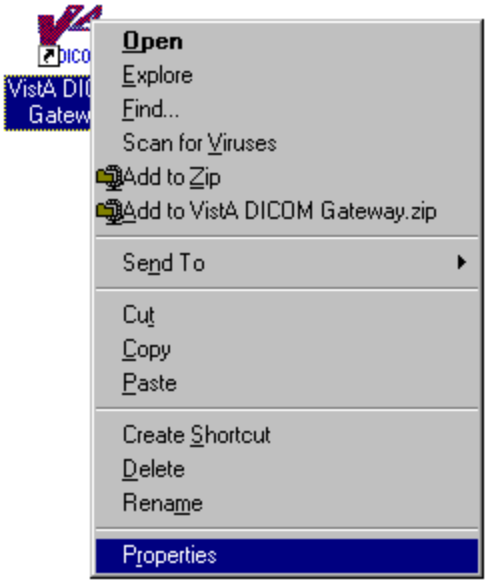
A.1 Short-Cuts

In the Microsoft Windows NT operating system the end-user may communicate with the operating system in a number of ways. One of the methods of starting a program is to double-click on an icon that is “linked” to the program. Such icons are also called “short-cuts”, “links” or “aliases”. As a part of the installation procedure, the **V*IST*A** Imaging DICOM Gateway Installation program will define a number of short-cuts that give access to the various programs that are used by the **V*IST*A** Imaging DICOM Gateway.

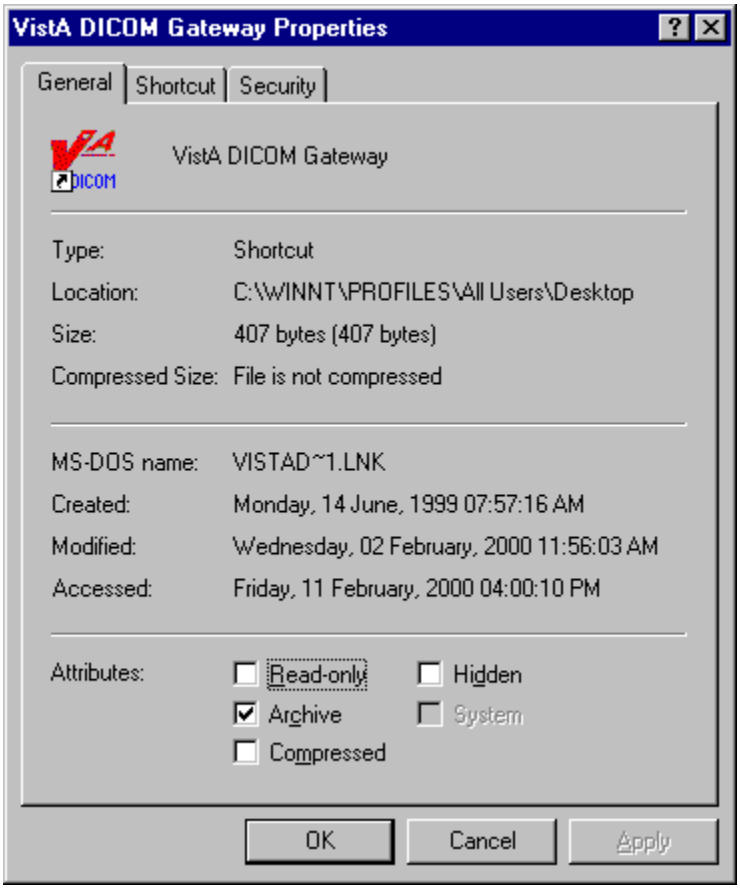
The installation program will create one icon on the desk-top, and when this icon is “double-clicked”, a window will open that shows the various parts of the **V*IST*A** Imaging DICOM Gateway software:

A.2 Defining a Short-Cut

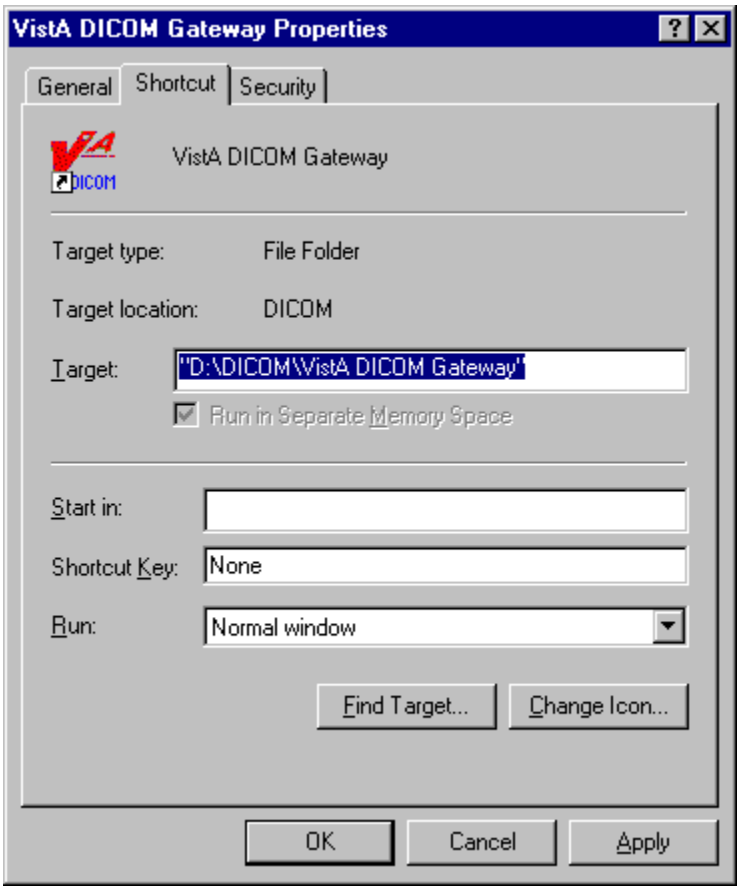
A short-cut has a number of parameters. These parameters can be defined and modified by right-clicking on the icon. When the mouse is clicked, a menu will appear, and one of the options on this menu is “Properties”.



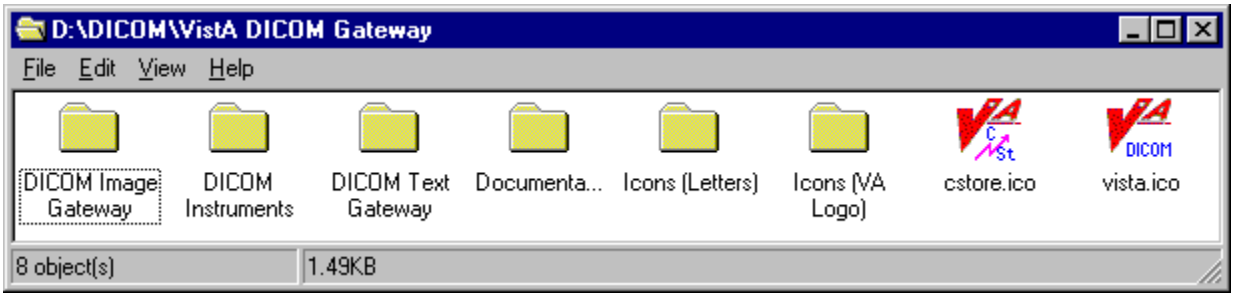
Once the menu option “**Properties**” is selected, a new window will pop up. In this window, select the tab labeled “Shortcut” to gain access to the next window.


VistA DICOM Gateway Properties
General
Shortcut
Security
VistA DICOM Gateway
Type: Shortcut
Location: C:\WINNT\PROFILES\All Users\Desktop
Size: 407 bytes (407 bytes)
Compressed Size: File is not compressed
MS-DOS name: VISTAD~1.LNK
Created: Monday, 14 June, 1999 07:57:16 AM
Modified: Wednesday, 02 February, 2000 11:56:03 AM
Accessed: Friday, 11 February, 2000 04:00:10 PM
Attributes:
Read-only
Hidden
Archive
System
Compressed
OK
Cancel
Apply

The next window can be used to modify any of the parameters about the "short-cut".



A.3 Short-Cuts for the VISTA Imaging DICOM Gateway



A.4 Directory Tree containing Short-Cuts

The installation program will define the following tree of short-cuts for easy access to the software. In this diagram, a number of abbreviations are used:

%SystemRoot% = The path-prefix for the directory that holds the Windows NT operating system, typically "**c:\winnt**\".

d1 = The drive on which the data is installed, typically "**d**".

d2 = The drive on which the common software is installed, typically "**c**".

d3 = The drive on which the MSM database is installed, typically "**c**".

d4 = The drive on which the text data is being stored, typically "**d**".

d5 = The drive on which the image data is being stored, typically "**d**".

```
...\DICOM\VistA DICOM Gateway
  |   Points to: d1:DICOM\VistA DICOM Gateway
  |   Icon: d1:DICOM\VistA DICOM Gateway\vista.ico, image # 0
  |
  +---DICOM Text Gateway
  |   |
  |   +---MSM Console
  |   |   Points to: d3:msm\msm.exe
  |   |   Working Directory: d3:msm
  |   |   Parameters: /autoconfig=DICOM
  |   |
  |   +---Command Prompt
  |   |   Points to: %SystemRoot%\System32\cmd.exe
  |   |   Working Directory: temp
  |   |
  |   +---Windows NT Explorer
  |   |   Points to: %SystemRoot%\explorer.exe
  |   |   Working Directory: d4:
  |   |
  |   +---Telnet
  |   |   Points to: %SystemRoot%\System32\telnet.exe
  |   |
  |   +---MSM Terminal
  |   |   Points to: %SystemRoot%\System32\telnet.exe
  |   |   Parameters: 127.0.0.1
  |   |
  |   +---Text Gateway
  |   |   Points to: %SystemRoot%\System32\telnet.exe
  |   |   Parameters: TEXT_GATEWAY_1_1
  |   |
  |   +---PACS Communications Status
  |   |   Points to: %SystemRoot%\System32\telnet.exe
  |   |   Parameters: PACS_COMMUNICATIONS_STATUS_1_3
  |   |
  |   +---Modality Worklist Status
  |       Points to: %SystemRoot%\System32\telnet.exe
  |       Parameters: MODALITY_WORKLIST_STATUS_1_4
```

```
|
+---DICOM Image Gateway
|   |
|   +---MSM Console
|   |   Points to: d3:msm\msm.exe
|   |   Working Directory: d3:msm
|   |   Parameters: /autoconfig=DICOM
|   |
|   +---Command Prompt
|   |   Points to: %SystemRoot%\System32\cmd.exe
|   |   Working Directory: temp
|   |
|   +---Windows NT Explorer
|   |   Points to: %SystemRoot%\explorer.exe
|   |   Working Directory: d5:
|   |
|   +---Telnet
|   |   Points to: %SystemRoot%\System32\telnet.exe
|   |
|   +---MSM Terminal
|   |   Points to: %SystemRoot%\System32\telnet.exe
|   |   Parameters: 127.0.0.1
|   |
|   +---Examination Complete
|   |   Points to: %SystemRoot%\System32\telnet.exe
|   |   Parameters: PACS_EXAMINATION_COMPLETE_2_1
|   |
|   +---Request Images
|   |   Points to: %SystemRoot%\System32\telnet.exe
|   |   Parameters: PACS_REQUEST_IMAGE_TRANSFER_2_2
|   |
|   +---Process DICOM Images
|   |   Points to: %SystemRoot%\System32\telnet.exe
|   |   Parameters: PROCESS_DICOM_IMAGES_2_3
|   |
|   +---Image Status
|   |   Points to: %SystemRoot%\System32\telnet.exe
|   |   Parameters: IMAGE_STATUS_2_5
|   |
|   +---DICOM Viewer
|       Points to: d2:\Program Files\VistA\Imaging\DCMView\DCMView.exe
|       Working Directory: d5:DICOM
|       Icon: d2:\Program Files\VistA\Imaging\DCMView\Viewer1.ico
|
+---DICOM Instruments
    |
    +---Default
        Points to: d2:\Program Files\VistA\Imaging\DICOM\cstore.exe
        Working Directory: d2:\Program Files\VistA\Imaging\DICOM
        Parameters: localhost 60000 default
        Icon: d1:\DICOM\VistA DICOM Gateway\CStore.ico, image # 0
```

Appendix B Master Files

B.1 Overview

The **V*IST*A** Imaging DICOM Gateway uses a number of tables to drive certain parameterized procedures within the **V*IST*A** Imaging DICOM Gateway software. These tables are populated from the data in a set of ASCII text files. In the context of the **V*IST*A** Imaging DICOM Gateway, these text files are called "master files".

Common usage within the Veterans Administration is to use the term "file" for a subtree of a global variable in MUMPS. The master files that are described in this chapter, however, are files in the more traditional sense: entities that live in directories within an operating system. In order to minimize confusion about the meaning of the term "file", this chapter will reserve the term "file" for entities outside of MUMPS, and the term "table" for databases within a MUMPS environment.

B.2 Master Files

The **V*IST*A** Imaging DICOM Gateway uses a number of FileMan tables to drive the **V*IST*A** Imaging DICOM Gateway software. These FileMan tables are populated from ASCII text data stored in master files located in a directory named **F:\DICOM\Dict**, (in this document the drive-letter **F:** is used, see sections 3.3 and 3.5.4). The actual name for this directory is stored by the **V*IST*A** Imaging DICOM Gateway software as data in **^MAGDICOM(2006.563,1,"DICT PATH")**.

B.2.1 Master File Menu Options

The menu of the **V*IST*A** Imaging DICOM Gateway has a number of options that each import one, some or all of the master files. These menu options are:

4. System Maintenance

→ 2. Gateway Configuration and DICOM Master Files

→ → 1. Display Gateway Configuration Parameters

→ → 2. Update Gateway Configuration

→ → 3. Update Instrument.DIC

→ → 4. Update Modality.DIC and Data*.DIC

→ → 5. Update PortList.DIC

→ → 6. Update SCU_List.DIC

→ → 7. Update WorkList.DIC

→ → 8. Reinitialize All the DICOM Master Files

There are two groups of master files, static ones that are the same for all sites, and site-configurable ones that must be edited at each site.

B.2.2 General Formatting Issues

- In all master files, lines that start with a number sign ("#") are comment lines.
- Text lines that do not start with a number sign contain dictionary data.
- While updating master files, blank lines and comment lines will be ignored.

Note: The final line in any master file must be followed by an "end-of-line" control sequence (carriage return and line feed). If the final "end-of-line" control sequence is missing, the line will be invisible to the software that updates the master files. In order to prevent this problem, all distributed versions of the master files end with the following comment line:

```
# End of File<CR><LF>
```

B.3 Static Master Files

This section describes the format and contents of the static master files, which are part of the release distribution of the **V*IST*A** Imaging.

Static master files in this category contain data that is the same for all sites. These files may not be modified by the sites (reference VA directive and FDA warning).

The following files are included in the release:

File Name	FileMan Table	MUMPS Routine	Comment
DataGECT.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
Data_CR.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
DataMisc.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
Data_MRI.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
Element.DIC	2006.51	^MAGDMFB2	Contains DICOM Standard data elements.
HL7.DIC	2006.57	^MAGDMFB7	Contains list of HL7 message templates.
SCP_List.DIC	2006.586	^MAGDMFB9	Contains lists of parameters for Provider Applications
Template.DIC	2006.52	^MAGDMFB3 ^MAGDMFB4	Contains templates for DICOM messages.
UID.DIC	2006.53	^MAGDMFB5	Contains list of unique DICOM identifiers.

B.3.1 Element.DIC

The file **F:\DICOM\Dict\Element.DIC** contains the DICOM data dictionary. As part of the installation process, this file is read by routine **^MAGDMB2** and is used to construct the FileMan table **DICOM Data Element Dictionary** (File 2006.51, stored in **^MAGDICOM(2006.51,…)**).

In a DICOM data stream, every data element is identified by a four-byte binary "tag" consisting of a two-byte group field and a two-byte element field. The tag value is usually represented by two groups of four hexadecimal digits, separated by a comma (group,element, e.g. 0010,21B0 for Additional Patient History). Odd-numbered groups denote private elements and are accompanied by an explicit owner identification code.

The file **F:\DICOM\Dict\Element.DIC** contains three kinds of records:

The first is the "group" record, which for odd-numbered groups defines the owner identification code for private elements. Following the group record are one or more "element" records that define each element and its set of attributes. Some of the element records are followed by optional "value" records, which define the legal set of enumerated values or defined terms for the element.

The values of an element are "enumerated values" when the value of that element may be one of an explicitly specified set of standard values, which shall not be extended by implementers.

The values of an element are "defined terms" when the value of that element may be one of an explicitly specified set of standard values, which may be extended by implementers.

The formats for the different record types are as follows:

- Group Record: <group> | <group owner> | <group title>
- Element Record: <tag> | <element name> | <value representation> | <multiplicity> | <value flag> | <retired flag>
- Value Record: <tag> | <permitted value>

The different fields are defined below:

<group>	The group identifier, expressed in four hexadecimal digits.
<group owner>	Blank for groups that are defined in the DICOM standard, and otherwise contains the name of or a mnemonic for the owner of the group.
<group title>	A name for the group for documentation purposes.
<tag>	Identifies the group and element(s), the value may contain hexadecimal digits and several wildcard characters.
<element name>	The name of the element (case-sensitive).
<value representation>	The 2-letter datatype mnemonic.
<multiplicity>	Identifies the (maximum) number of values that may be passed at a time.
<retired flag>	An identifier that denotes that the element is no longer current.
<permitted value>	The enumerated value or defined term, along with its meaning.

Example:

```
0010||Patient Information
0010,0000|Group Length|UL|1||
0010,0010|Patient's Name|PN|1||
0010,0020|Patient ID|LO|1||
0010,0021|Issuer of Patient ID|LO|1||
0010,0030|Patient's Birth Date|DA|1||
0010,0032|Patient's Birth Time|TM|1||
0010,0040|Patient's Sex|CS|1|E|
0010,0040|M=male
0010,0040|F=female
0010,0040|O=other
0039|VA DHCP|Admission, Discharge, and Transfer Information Shadow
0039,0000|Group Length|UL|1||
0039,0010:1:00FF|Owner of Group|LO|1||
0039,xx10|Current Patient Location Sequence|SQ|1||
0039,xx20|Patient's Institutional Residence Sequence|SQ|1||
```

When a <tag> contains an "x", this means that it is a private element and the same definition applies to all tags that have any hexadecimal digit in the position of that "x".

When a tag contains a value of the format <start>:<step>:<end>, this means that the same definition applies to all values covered by that range definition.

The information in Element.DIC is extracted directly from the DICOM standard (element definitions are specified in **Part 6: Data Dictionary (PS 3.6)**; lists of permitted values are specified in **Part 3: Information Object Definitions (PS 3.3)**).

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.51,d0,0) = group , element [ , owner ] ^ name ^ VR ^ mult ^ flag

^MAGDICOM(2006.51,d0,1,d1,0) = value ^ meaning

^MAGDICOM(2006.51,"B", group element [owner], d0) = ""

^MAGDICOM(2006.51,d0,1,"B",value,d1) = ""
```

B.3.2 HL7.DIC

The file **F:\DICOM\Dict\HL7.DIC** contains the definitions of the recognized HL7 messages. As part of the installation process, this file is read by routine **^MAGDMB7** and is used to construct the FileMan table **DICOM HL7 SEGMENT** (File 2006.57, stored in **^MAGDICOM(HL7,…)**).

The routine **^MAGDHRP** uses the values in this table to produce a formatted HL7 message listing.

Each record consists of two parts. The first part is either the HL7 segment identifier (if it is alphanumeric), or it contains the HL7 segment field number (if it is numeric). The second piece is text that defines either the name of the segment or the name of the field.

Example of an HL7 segment with its fields:

```
PID|Patient Identification Segment
1|Set ID - Patient ID
2|Patient ID (External ID)
3|Patient ID (Internal ID)
```

```
4|Alternate Patient ID
5|Patient Name
6|Mother's Maiden Name
7|Date of Birth
8|Sex
9|Patient Alias
10|Race
11|Patient Address
12|Country Code
13|Phone Number - Home
14|Phone Number - Business
15|Language - Patient
16|Marital Status
17|Religion
18|Patient Account Number
19|SSN Number - Patient
20|Driver's Lic Num - Patient
21|Mother's Identifier
22|Ethnic Group
```

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM("HL7",d0,0) = segment ^ name of segment

^MAGDICOM("HL7",d0,1,d1,0) = name of element

^MAGDICOM("HL7","B",segment,d0) = ""
```

B.3.3 SCP_List.DIC

The file **F:\DICOM\Dict\SCP_List.DIC** contains the definitions of the applications that are supported by the **V*IST*A** Imaging DICOM Gateway operating in the role of a **S**ervice **C**lass **P**rovider (SCP). As part of the installation process, this file is read by routine **^MAGDMB9** and is used to construct the FileMan table **Provider Application List** (File 2006.586, stored in **^MAGDICOM(2006.586,…)**).

There are three kinds of records in the file **F:\DICOM\Dict\SCP_List.DIC**. The first is the "application" record, which identifies the name of the **V*IST*A** service class provider. Following the application record are one or more "service" records defining the services that may be utilized. Following a "service" record, there is at least one "transfer syntax" record, defining how information may be exchanged.

- Application Record: <called AE title> | <application name>
- Service Record: | <SOP Class>
- Transfer Syntax Record: | | <syntax>

The different fields are defined below:

<called AE title> The title of the called **V*IST*A** provider (SCP) application entity.

<application name> The name that **V*IST*A** uses to refer to the DICOM application.

<SOP Class> The name of the DICOM service object pair (SOP).

<syntax> is the name of a supported transfer syntax

Currently, there are two possible transfer syntax's:

1. Implicit VR, Little Endian
2. Explicit VR, Little Endian

Example of entries in SCP_LIST.DIC:

```
# VistA Service Class Providers
# <VistA Application Entity Title> | <application name>
# | <supported SOP class>
#
VISTA_WORKLIST|VistA Modality Worklist
|Verification SOP Class
||Implicit VR Little Endian
|Modality Worklist Information Model – FIND
||Implicit VR Little Endian
#
VISTA_STORAGE|VistA Storage
|Verification SOP Class
||Explicit VR Little Endian
||Implicit VR Little Endian
|Computed Radiography Image Storage
||Explicit VR Little Endian
||Implicit VR Little Endian
|CT Image Storage
||Explicit VR Little Endian
||Implicit VR Little Endian
|Ultrasound Multi-frame Image Storage (retired)
||Explicit VR Little Endian
||Implicit VR Little Endian
#
```

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.586,d0,0) = AE Title ^ Application name

^MAGDICOM(2006.586,d0,1,d1,0) = SOP Class UID ^ SOP Class Name

^MAGDICOM(2006.586,d0,1,d1,1,d2,0)

                                = Transfer Syntax UID ^ Transfer Syntax Name

^MAGDICOM(2006.586,"B",AE Title,d0) = ""

^MAGDICOM(2006.586,d0,1,"B",SOP Class UID,d1) = ""

^MAGDICOM(2006.586,d0,1,d1,1,"B",Transfer Syntax UID,d2) = ""
```

B.3.4 Template.DIC

The file **F:\DICOM\Dict\Template.DIC** contains model definitions of the messages that are supported by the **V*IST*A** Imaging DICOM Gateway. As part of the installation process, this file is read by routines **^MAGDMB3** and **^MAGDMFB4** and is used to construct the file **F:\DICOM\Dict\Template.TMP** and the FileMan table **DICOM Message Template Dictionary** (File 2006.52, stored in **^MAGDICOM(2006.52,…)**).

DICOM data elements are the attributes of the Service Classes and the Information Object Definitions. The service classes and information object definitions are joined together to form the Service-Object Pair (SOP) classes. The SOP classes are the high-level communications message protocol units of DICOM.

The file **F:\DICOM\Dict\Template.DIC** defines the way that the DICOM data elements are combined to make up the SOP Classes. The file **F:\DICOM\Dict\Template.DIC** contains attributes of the service classes, the information object definition modules, and the SOP classes. Because the same set of attributes is often repeated in several different SOP classes, the gateway master file update software uses a "macro" facility so that the attributes can be defined once and used multiple times. The file **F:\DICOM\Dict\Template.DIC** is "expanded" by the macro facility (routine **^MAGDMFM4**) to create the file **F:\DICOM\Dict\Template.TMP**, which contains the model of each DICOM message. The routine **^MAGDMFB3** routine invokes **^MAGDMFM4** to expand the macros, and then reads the resulting file **F:\DICOM\Dict\Template.TMP** to populate the FileMan table in global variable ^MAGDICOM(2006.52).

The format for the macro definitions is as follows:

```
{$define <name of macro>}

<body of macro>

{$end <name of macro>}
```

The macro facility performs simple text replacement. When a macro is invoked, the invocation is replaced by the macro text. The format for a macro invocation is {<name of macro>}. The macro invocation is replaced with <body of macro> in the expanded text. Macros may be nested.

The <body of macro> (i.e., the macro text) consists of a sequence of DICOM Element Records and (optional) Macro Invocation Records. The formats for these two type of records is as follows:

- Element Record: <element name> | <tag> | <group owner> | <SCP/SCU Type> | <default value>
- Macro Invocation: {<name of macro>}

The different fields are defined below:

<element name> The case-sensitive name of the element.

<tag> The group and element numbers, in (gggg,eeee) hexadecimal format.

<group owner> The name/mnemonic for the owner of the group.

<SCP/SCU Type> The SCP and SCU DICOM Type (1, 1C, 2, 3, etc.).

<default value> The default value of the element in the message.

Example of a macro definition:

```
{$define N-EVENT-REPORT-RQ}
Affected SOP Class UID|(0000,0002)||1/1|
Command Field|(0000,0100)||1/1|0100H
Message ID|(0000,0110)||1/1|
Priority|(0000,0700)||1/1|
Data Set Type|(0000,0800)||1/1|0003H
Affected SOP Instance UID|(0000,1000)||1/1|
Event Type ID|(0000,1002)||1/1|
{$end N-EVENT-REPORT-RQ}
```

Macros are used for building model message templates.

A message template consists of four different types of records. The "template" record identifies the beginning of the message template. The "SOP" record defines the SOP class for the template. The "element" and "macro invocation" records define the element attributes of the template. These records are defined below:

- Template Record: $TEMPLATE | <message name> | <DIMSE> |
  <typename> | <typeid>
- SOP Record: $SOP | <SOP class name>
- Element Record: <element name> | <tag> | <group owner> |
  <SCP/SCU Type> | <default value>
- Macro Invocation: {<name of macro>}

The different fields for the "template" and "sop" records are defined below:

<message name> The name of the template.

<DIMSE> The DICOM Message Service Element.

<typename> The DICOM Event Type Name.

<typeid> The DICOM Event Type Id.

<SOP class name> The case-sensitive name of the SOP class defined in the UID.DIC file.

(Refer to the **DICOM standard, Part 4 Service Class Specifications (PS 3.4)** for the definition of the DICOM terms.)

Example of a template definition:

```
$TEMPLATE|PATIENT DEMOGRAPHIC CHANGE|N-EVENT-REPORT|Patient Updated|3|
$SOP|VA Detached Patient Management SOP Class
{N-EVENT-REPORT-RQ}
Instance Creation Date|(0008,0012)||-/2|
Instance Creation Time|(0008,0013)||-/2|
Instance Creator UID|(0008,0014)||-/2|
{Patient Data}
{Message Handle}
```

The element information in the file **F:\DICOM\Dict\Template.DIC** is extracted directly from the DICOM standard, **Part 6: Data Dictionary (PS 3.6)** and **Part 7:Message Exchange (PS 3.7)**. The list of attributes comes from **Part 3: Information Object Definitions (PS 3.3)** and **Part 7:Message Exchange (PS 3.7)**.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.52,d0,0) = Title ^ DIMSE ^ SOP Class ^ Type Name ^ Type ID

^MAGDICOM(2006.52,d0,1,d2,0) = tag ^ name ^ SCP type / SCU type

                                                          ^ Value ^ Pointer

^MAGDICOM(2006.52,"B",Title,d0) = ""
```

B.3.5 UID.DIC

The file **F:\DICOM\Dict\UID.DIC** contains the definitions of the unique identifiers for SOP classes, transfer syntax's and class instances for the DICOM standard. As part of the installation process, this file is read by routine **^MAGDMB5** and is used to construct the FileMan table **DICOM UID Dictionary** (File 2006.53, stored in **^MAGDICOM(2006.53,…)**).

DICOM uses a unique object identification scheme based upon ISO-9834-3. This standard uses numeric fields separated by periods that are assigned in a left-to-right hierarchical fashion in order to allow uniqueness. All DICOM standard UIDs have the root **1.2.840.10008**, and UIDs generated by the VA have the root **1.2.840.113754**.

The file **F:\DICOM\Dict\UID.DIC** contains all the pre-defined UID values that are used by the **V*IST*A** DICOM applications.

The file UID.DIC contains two types of records:

- UID Record:<UID Value> | <UID Name> | <UID Type> | <Reference> | <Function>
- Meta Record| <UID Value> | <UID Name>

When a UID identifies a Meta SOP Class, the record for the Meta SOP Class will be followed by one or more Meta records. In such a case, each Meta record defines one UID that identifies a SOP class that is a member of the Meta SOP class.

The different fields are defined below:

<UID Value> The unique period delimited numeric string that represents the value of the UID

<UID Name> The text name for the UID; 1:1 mapping between <UID Value> and <UID NAME>.

<UID Type> Indicates the usage for the UID.

<Reference> Documents where the UID is officially defined.

<Function> Identifies which UIDs are supported by **V*IST*A** Storage (for example, S for Storage).

Example of some UID definitions:

```
1.2.840.10008.1.1|Verification SOP Class|SOP Class|Part 4|*
1.2.840.10008.3.1.2.1.4|Detached Patient Management Meta SOP Class
                                                    |Meta SOP Class|Part 4|
|1.2.840.10008.3.1.2.1.1|Detached Patient Management SOP Class
|1.2.840.10008.3.1.2.2.1|Detached Visit Management SOP Class
1.2.840.113754.3.1.2.1.4|VA Detached Patient Management Meta SOP Class
                                                   |Meta SOP Class|Part 4|S
|1.2.840.113754.3.1.2.1.1|VA Detached Patient Management SOP Class
|1.2.840.113754.3.1.2.2.1|VA Detached Visit Management SOP Class
```

The UID information in the file **F:\DICOM\Dict\UID.DIC** is extracted directly from the DICOM Standard, **Part 6: Data Dictionary (PS 3.6)** and material supplied by the Imaging Project.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.53,d0,0) = Name ^ UID Code ^ Type ^ Reference

^MAGDICOM(2006.53,d0,1,d1,0) = Name ^ UID Code

^MAGDICOM(2006.53,"B",Name,d0)= ""

^MAGDICOM(2006.53,"C",UID Code,d0) = ""

^MAGDICOM(2006.53,d0,1,"B",Name,d1) = ""

^MAGDICOM(2006.53,d0,1,"C",UID Code,d1) = ""
```

B.3.6 Additional Data

Certain DICOM elements are extracted from the DICOM image header and copied into the "about image" text file when an image is processed. These data items are then displayed on the diagnostic workstation with the image.

Different items may be selected and displayed for different modalities. Currently, the following files with lists of additional data-items are available:

- DataGECT.DIC (specific for CT equipment from General Electric and others)
- Data_CR.DIC (specific for CR equipment)
- DataMisc.DIC (general for any other equipment)
- Data_MRI.DIC (specific for MRI equipment)

In these files, each line that defines a data-item consists of two parts: the first part identifies an attribute tag and the second part specifies an attribute name, e.g.:

```
0008,0070|Manufacturer
```

The data from these files is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.511,d0,0) = filename

^MAGDICOM(2006.511,d0,1,d1,0)=tag ^ name

^MAGDICOM(2006.511,"B",filename,d0) = ""
```

B.3.6.1 DataMisc.DIC

The file DataMisc.DIC contains a list of general-purpose elements to be displayed. These data-items are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,5100|Patient Position
0020,0010|Study ID
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
```

```
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

In the lists below, the highlighted lines are additional fields.

B.3.6.2 DataGECT.DIC

The data-items for CTs from General Electric (and other manufacturers) are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,0050|Slice Thickness
0018,0060|KVP
0018,1100|Reconstruction Diameter
0018,1120|Gantry/Detector Tilt
0018,1150|Exposure Time
0018,1151|X-ray Tube Current
0018,1190|Focal Spot(s)
0018,1210|Convolution Kernel
0018,5100|Patient Position
0020,0010|Study ID
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0020,0060|Laterality
0020,1040|Position Reference Indicator
0020,1041|Slice Location
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

B.3.6.3 Data_CR.DIC

The data-items for CRs are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,1004|Plate ID
```

```
0018,1400|Acquisition Device Processing Description
0018,1405|Relative X-ray Exposure
0018,5100|Patient Position
0018,6000|Sensitivity
0020,0010|Study ID
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

B.3.6.4 Data_MRI.DIC

The data items for MRIs are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,0020|Scanning Sequence
0018,0080|Repetition Time
0018,0081|Echo Time
0018,0083|Number of Averages
0018,0091|Echo Train Length
0018,1310|Acquisition Matrix
0018,5100|Patient Position
0020,0010|Study ID
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

B.3.7 Display of Overlay Text Data on VISTA Rad Workstations

The displaying of the values of these data fields on a **VISTA** Rad workstation involves several steps:

1. The value for a data field is originally obtained when each image is processed, and is written to the "about image" text file.

2. When the image is to be displayed, the value for the data field is retrieved from the "about image" text file.

3. The location for displaying the value on the image is determined by the overlay template dictionary.

When an image is processed, an "about image" text file is created. This file has the name xxnnnnn.TXT and contains the values of the various data fields in human-readable form. Based on the entries in the files described in the sections below, additional data fields may be included when these files are created.

For example, a ".TXT" file for a CR-image could look like:

```
$$BEGIN DATA1
PATIENTS NAME=GISWEKZ,SAVKEFTE W
PATIENTS_ID=672-62-1643
PATIENTS_BIRTH_DATE=JAN 24,1934
PATIENTS AGE=65
PATIENTS SEX=M
IMAGE DATE=08/30/1999
IMAGE_TIME=14:19:00
IMAGE_TYPE=2
IMAGE_TYPE(1)=DERIVED
IMAGE_TYPE(2)=PRIMARY
MODALITY=CR
MANUFACTURER=DeJarnette Research Systems
INSTITUTION_NAME=V.A. WICHITA
MANUFACTURERS_MODEL_NAME=ImageShare CR
CONTRAST_BOLUS_AGENT=<unknown>
STUDY_ID=<unknown>
SERIES_NUMBER=1
IMAGE_NUMBER=1
PHOTOMETRIC_INTERPRETATION=MONOCHROME2
ROWS=2140
COLUMNS=1760
PIXEL_SPACING=2
PIXEL_SPACING(1)=0.2000
PIXEL_SPACING(2)=0.2000
BITS_STORED=10
HIGH_BIT=9
PIXEL_REPRESENTATION=0
$$END DATA1
$$BEGIN DICOM DATA
0002,0000|Group Length|1,1|210
0002,0001|File Meta Information Version|1,1|0
0002,0001|File Meta Information Version|2,1|1
. . .
7FE0,0010|Pixel Data|1,1|<image>
7FE0,0010|Pixel Data|1,2|length=7532800 (0x0072F100)
```

```
7FE0,0010|Pixel Data|1,3|offset=1338 (0x053A)
$$END DICOM DATA
```

The display software will obtain the values from the information in the ".TXT" files.

The location where each of these values is to be placed on the image is specified in **V***IST***A** Rad Overlay Templates. These templates are stored in files with names that end in ".OVL". A template file for a CR image could look like:

```
$$rem File: tmp_cr.ovl (VistARad Overlay Template)
$$rem
$$rem CR_1 -- Format Definition for CR text data display
$$rem
$$begin region 1
%Image Date%
%Image_Time%
$$end region 1
$$rem
$$begin region 3
%Institution Name%
%Patients Name%
%Patients_Age%  %Patients_Sex%  %Patients_ID%

$$end region 3
```

The "regions" in this template decide where the various data fields are to be displayed. The window containing the image is subdivided into nine adjacent regions. These regions are numbered as shown below:

1	**2**	**3**
4	**5**	**6**
7	**8**	**9**

In each region, text is "pushed" to the outer edge of the box for that region.

For each region, overlay text is displayed if the template file contains a section for that region (i.e., there is a block that is delimited by `$$begin region` *n* and `$$end region` *n*). Within the region, text is copied literally from the template file, and strings that are enclosed in percent signs ("%") are assumed to be field names and are replaced with the actual values found in the ".TXT" file. If a ".TXT" file does not contain an actual value for a data field that is specified in a template file, the text string that replaces the name between %-signs will be empty (zero characters).

In the above example, the resulting overlay would only affect regions 1 and three, causing the top of the image to look like:

08/30/1999 14:19:00		V.A. WICHITA GISWEKZ,SAVKEFTE W 65 M 672-62-1643

B.4 Site-Specific Master Files

This section describes the format and contents of the site-specific master files.

Currently, the following files exist:

File Name	FileMan Table	MUMPS Routine	Comment
Instrument.DIC	2006.581	^MAGDMFB8	Contains list of operational instruments.
Modality.DIC	2006.582	^MAGMFB8	Contains list of parameters for handling modalities.
Portlist.DIC	2006.584	^MAGMFB8	Contains list of port numbers for handling instruments.
SCU_List.DIC	2006.585	^MAGMFB9	Contains lists of parameters for User Applications.
Worklist.DIC	2006.583	^MAGMFB8	Contains list of parameter for Modality Worklist handling.

The contents of the files in this section need to be customized to reflect the actual attributes used at the site.

Note: These changes should be made to the text file dictionaries in **F:\DICOM\Dict** only. The software will load this information from these dictionary files into the global variables, overwriting any previously saved information.

B.4.1 Instrument.DIC

The file **F:\DICOM\Dict\Instrument.DIC** contains the definitions of the various image acquisition devices that are being used at the site. This file is read by routine **^MAGDMB8** to (re)construct the FileMan table **Instrument Dictionary** (File 2006.581, stored in **^MAGDICOM(2006.581,…)**). This is done as part of the installation process, and whenever operational information has changed at the site.

Use the **V*IST*A** Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance

→ 2. Gateway Configuration and DICOM Master Files

→ → 2. Update Instrument.DIC

Each image producing instrument must send its images to a **V*IST*A** storage provider. In the **V*IST*A** DICOM Image Gateway, there is a separate storage provider process running on a dedicated network port for each instrument that produces images. The file **F:\DICOM\Dict\Instrument.DIC** lists each image producing instrument and its dedicated communications port, along with its corresponding imaging service.

An entry in the file **F:\DICOM\Dict\Instrument.DIC** is formatted as follows:

<mnemonic> | <description> | <institution name> | <imaging service> | <port> [| <machine]

The different fields are defined below:

<mnemonic>	is a short code for the instrument created by the site (it must be unique). Typically abbreviations like **CR1**, **CT2**, **NM, GI-FLUORO**, and so forth.
<description>	is free text describing the instrument and its location.
<institution name>	is text describing the name of the facility where the image acquisition occurs must be spelled exactly as registered in the "Institution file", ^DIC(4,…).
<imaging service>	indicates where the orders and reports are placed on the hospital information system ("RAD" or "MED-ENDO" – see below)
<port>	is the network communications port number (this must be unique, see Appendix E)
<machine>	identifies the Image Gateway computer that will receive image files from this instrument (optional parameter, free text)

Example of a portion of the INSTRUMENT.DIC file:

```
# Computed Radiography
CR1|Fuji AC3 CR, Room 2156|Wilmington, DE|RAD|60050|A
CR2|Fuji AC3 CR, Room 2160 (Chest)|Wilmington, DE|RAD|60051|C
CR3|Fuji AC3 CR, Cubby, 2145 Hallway|Wilmington, DE|RAD|60052
#
# Computed Tomography
CT1|GE High Speed Advantage, Room 2142|Wilmington, DE|RAD|60060|A
#
```

In the above example, please observe that there are **four** different instruments and **two** different modalities.

The site must create an entry in the file **F:\DICOM\Dict\Instrument.DIC** for each piece of equipment that is going to produce images and send them to **V*IST*A**. Otherwise, images cannot be acquired from the equipment.

Please note that the port numbers must be unique. This is true even in the situation where several different **V*IST*A** DICOM Image Gateways are used. By making the port numbers unique, it is possible to redirect the output of any image producing instrument to a different **V*IST*A** DICOM Image Gateway by adding a second IP address to the gateway. The recommended port number scheme is included in Appendix E.

Names of institutions must be spelled exactly as in the Institution File (File number 4, stored in `^DIC(4,...)`). These names are processed in a case-insensitive fashion. Only the part of the name before the first comma needs to match the value in the institution file. Any other punctuation characters that occur in that part of the "official" name must appear in the value that is entered here.

If no name is specified for the name of an institution, the default value from the Kernel Site Parameter in **^DD("SITE",1)** will be used.

Names of imaging services must be spelled as in the **Imaging Service** File (File number 2006.589, stored in `^MAGDICOM(2006.589,…)`. These names must be spelled in all upper-case characters. Currently, only "**RAD**" and "**MED-ENDO**" are supported.

The optional 6th parameter identifies the Image Gateway to which the instrument will transmit its image files. Such identifiers are single character codes (see section 4.3.6).

A sample file **F:\DICOM\Dict\Instrument.Sample** is supplied with the **V*IST*A** Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\Instrument.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be manually transferred to the operational master file at the discretion of the site.

The data from this file is stored in MUMPS in the following structure:

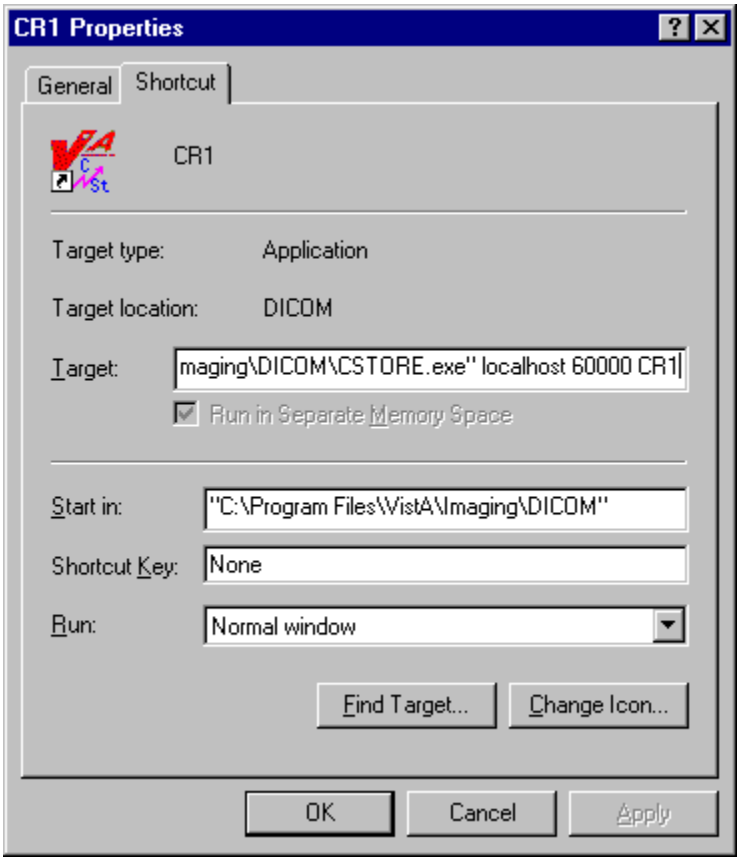
```
^MAGDICOM(2006.581,d0,0) = Nickname ^ Description ^ Service ^ Port ^ Site ^
Machine
```

```
^MAGDICOM(2006.581,"B",Nickname,d0) = "
```

B.4.1.1 Icons for Instruments

Normally, icons will be generated for all instruments at the end of an installation when the program ^MAGDMFIC is run. The Site Manager can then adjust the icons in the window to show only those storage providers that are actually being used on the current PC.

When set-up parameters need to be modified for one of these icons, it is important to know the values that should be entered. The typical values for each of these icons are shown below.



In the example above, the complete value for "target" would be:

```
"C:\Program Files\VistA\Imaging\DICOM\CSTORE.exe" localhost 60000 CR1
```

Note: The quotes around the path-name for the C-Store program are required.

The entry for "Target" should link the icon to the "C-Store" program, and specify the parameters:

- IP-address is always "**localhost**" (never modify this value).
- Port number is always **60000** (never modify this value).

- Instrument name is the abbreviation for the instrument, e.g. "**CR1**" (only modify this value to reflect changes made in the master file **F:\DICOM\Dict\Instrument.DIC**).

The icon can be changed to be more descriptive for the type of instrument. For CRs, the distributed system provides two sample icons:

The end-user may select any other icon that would be more descriptive of the instrument.

B.4.2 Modality.DIC

The file **F:\DICOM\Dict\Modality.DIC** contains the definitions of the parameters that are needed to process image files, store them on the NT file server, and associate them with the patient record. This file is read by routine **^MAGDMB8** to (re)construct the FileMan table **Modality Type Dictionary** (File 2006.582, stored in **^MAGDICOM(2006.582,…)**). This is done as part of the installation process, and whenever operational information has changed at the site.

Use the **V*IST*A** Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance

→ 2. Gateway Configuration and DICOM Master Files

→ → 3. Update Modality.DIC and Data*.DIC

B.4.2.1 Image Processing Overview

After images have been acquired, they have to be processed and incorporated into the patient medical record. The rules for processing the images produced by each different kind of modality are stored in the file **F:\DICOM\Dict\Modality.DIC**.

Each time an image is processed, the following steps will be taken:

1. The patient and study information is extracted from the image header.
2. The study is looked up on **V*IST*A** using the patient and study information from the image header.
3. The image is converted into TARGA™ (*.TGA) format and the image abstract (also known as thumbnail or icon) is created.
4. Some image information is saved in a text (*.TXT) file for display purposes.

5. All image attributes from the header are saved in a text (*.TXT) file for later regeneration of files in DICOM format (*.DCM).

B.4.2.2 Assigning Field Values for the Modality Dictionary

The details of these steps are controlled through the various fields in the file **F:\DICOM\Dict\Modality.DIC**. There must be one entry in that file for each different image producing modality. There may be multiple entries for an instrument, if it produces more than one type of image. The lookup in this dictionary file uses a composite key consisting of the triplet {manufacturer, model, modality}.

Note: These values may be set to asterisk (i.e., "*") if the instrument does not supply their values in the headers of the image files.

• Modality Record: <mfgr> | <model> | <modality> | <image processing rules> | <accession number code> | <text data code> | <text data file>

The different fields are defined below:

<mfgr>	The manufacturer of the equipment producing the images; element (0008,0070).
<model>	The manufacturer's model name for the equipment; element (0008,1090).
<modality>	The official DICOM defined term for the modality; element (0008,0060).
<image processing rules>	Control the conversion of the image from DICOM to Targa file format.
<accession number code>	M routine name used to extract the accession number from image header.
<text data code>	M routine for outputting text data (*.TXT) for diagnostic workstation.
<text data file>	Lists DICOM attributes to output as text (*.TXT) for diagnostic workstation (see Appendix B.3.6 for a description of the format of a text data file).

Note: The above fields require exact matches.

B.4.2.2.1 Image Processing Rules - Setup

Images are converted from the DICOM format to the Targa™ format by the program DCMTOTGA.EXE program. The image processing rules are parameters to DCMTOTGA, and control the conversion process. They are listed below (in the context of this table, *nnn* represents an unsigned integer number):

A*nnn* Add *nnn* to each pixel (before the minimum/maximum check is performed).

B*nnn** Specifies the number of bits in the original pixel.

C*nnn* Ceiling (maximum) pixel value; any value > *nnn* is replaced by *nnn.*

F*nnn* Floor (minimum) pixel value; any value < *nnn* is replaced by *nnn.*

I Invert each pixel.

O*nnn** Byte offset in the DICOM file to the image.

R1 Reduce the size of the image file by outputting the low-order byte of a two-byte pixel.

R2 Reduce the size of the image file two by shifting two-byte pixels into one-byte pixels.

R4 Reduce the size of the image by four by combining four pixels into one two-byte pixel.

R8 Reduce the size of the image by eight by combining four pixels into one one-byte pixel.

S*nnn* Subtract *nnn* from each pixel (unsigned arithmetic, executed before add is performed).

X*nnn** X-dimension of the image (horizontal width or the number of columns).

Note: Images with an odd number of columns may not be processed properly.

Y*nnn** Y-dimension of the image (vertical height or the number of rows).

The parameters designated with an asterisk ("*") are required; all the others are optional. The rule letters are not case sensitive. Two sets of rules, separated by a slash ("/"), can be placed in the <image processing rules> field of the modality record. The first set are used for the production of the Targa™ file, and the second set (optional) are used for the production of the "Big" file, which is used by the diagnostic workstation (This is optional and is only done for Computed Radiography, Digital Radiography, and digitized film).

B.4.2.2.1.1 Typical Values for Image Conversion Parameters

Parameter Value	Equipment
b8	Accession, Sequoia, US
b12 f0 c4095	ADAC, *, NM
b12 f0 c4095	ADAC, Solus, NM
b12 f0 c4095	ADAC, Vertex, NM
B12 F0 C4095 R8	AGFA, ADC 5145, CR
b8	Aspect Electronics, Inc., Access Acquisition Module, US and OT
b8 f0	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US
b10 f0 c1023 R8/b10 f0 c1023	DeJarnette Research Systems, ImageShare CR, CR
b10 f0 c1023 R8/b10 f0 c1023	DeJarnette Research Systems, Imageshare Fuji CR Acquisition Station, CR
b8	Diasonics, *, US
b10	GE Medical Systems, DLX, XA
b8	GE Medical Systems, DRS, RF
b12 f0	GE Medical Systems, Genesis CT9800 QHL, CT
b12 f0	GE Medical Systems, Genesis HiSpeed RP, CT
b12 f0	GE Medical Systems, Genesis Jupiter, CT
b12 f0	GE Medical Systems, Genesis Signa, MR
b12 f0	GE Medical Systems, HiSpeed CT/i, CT
b12 f0	GE Medical Systems, HiSpeed RP, CT
a1000 b12 f0 c4095	GE Medical Systems, ProSpeed, CT

Parameter Value	Equipment
b12 f0	GE Medical Systems, Rhapsode, CT
b12 f0 c4095 R8	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
b12 f0 c4095 R8	Lumisys, LS75, CR, CT, MR, MRI, NM, OT, RAD, SC and US
b12 f0 c4095	Picker International, Inc., AX000, MR
b12 f0 c4095	Picker International, Inc., Edge 1.5T, MR
b16 a1000 f0 c4095	Picker International, Inc., Polaris, CT
b12 a1000 f0 c4095	Picker International, Inc., PQ2000, CT
b12 a1000 f0 c4095	Picker International, Inc., PQ2000, SC
b12 a1000 f0 c4095	Picker International, Inc., PQ5000, CT
b12 a1000 f0 c4095	Picker International, Inc., PQ5000, SC
b12 a1000 f0 c4095	Picker International, Inc., PQ6000, CT
b12 a1000 f0 c4095	Picker International, Inc., PQS, CT
b12 a1000 f0 c4095	Picker International, Inc., PQS, SC
b12 a1000 f0 c4095	Picker International, Inc., VOXEL, CT
b12 a1000 f0 c4095	Picker International, Inc., VOXELQ, CT
B8	VAMC Image Acquisition Corporation, VA Image Camera, OT

The parameter value for the Fuji CR (labeled above as "DeJarnette Research Systems Imageshare") consists of two parts. The first part is used to create the clinician's down-sampled image file and the second is used to create the full diagnostic resolution image file, which is referred to as the .BIG file.

B.4.2.2.2 Accession Number Extraction Subroutines

The names of the MUMPS routines for extracting the accession number from the image header, and for outputting formatted text for display on the diagnostic workstation, are defined by the **V***IST***A** Imaging Project.

Possible names of subroutines that extract Accession Numbers are:

Line Tag^Routine	Description
IGNORE^MAGDIR3	Ignore Image
STUDYUID^MAGDIR3	Get from a **V*IST*A** -generated Study Instance UID
GEMSPACS^MAGDIR3	GE Medical Systems PACS
PQ2000^MAGDIR3	Picker PQ 2000 CT
GECTHISA^MAGDIR3	GE High Speed Advantage CT
GEDRS^MAGDIR3	GE Digital Radiography System
LONGCASE^MAGDIR3	Long Case Number
PIDCASE^MAGDIR3	PID after SSN
PIDCASE2^MAGDIR3	PID after //
STUDYID^MAGDIR3	Study ID with Long Case Number
ADACNM^MAGDIR3	ADAC Nuclear Medicine
SERDESC^MAGDIR3	ADAC Nuclear Medicine, Solus
PNAME^MAGDIR3	After Patient Name
MEDCASE^MAGDIR3	Medicine Capture

B.4.2.2.2.1 Typical Values for Accession Number Subroutine

Parameter Value	Equipment
PNAME^MAGDIR3	Accuson, Sequoia, US
LONGCASE^MAGDIR3	ADAC, *, NM
LONGCASE^MAGDIR3	ADAC, Solus, NM
LONGCASE^MAGDIR3	ADAC, Vertex, NM
LONGCASE^MAGDIR3	AGFA, ADC 5145, CR

Parameter Value	Equipment
PIDCASE^MAGDIR3	Aspect Electronics, Inc., Access Acquisition Module, US and OT
LONGCASE^MAGDIR3	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US
LONGCASE^MAGDIR3	DeJarnette Research Systems, ImageShare CR, CR
LONGCASE^MAGDIR3	DeJarnette Research Systems, Imageshare Fuji CR Acquisition Station, CR
PNAME^MAGDIR3	Diasonics, *, US
STUDYID^MAGDIR3	GE Medical Systems, DLX, XA
GEDRS^MAGDIR3	GE Medical Systems, DRS, RF
LONGCASE^MAGDIR3	GE Medical Systems, Genesis CT9800 QHL, CT
GECTHISA^MAGDIR3	GE Medical Systems, Genesis HiSpeed RP, CT
GECT^MAGDIR3	GE Medical Systems, Genesis Jupiter, CT
LONGCASE^MAGDIR3	GE Medical Systems, Genesis Signa, MR
LONGCASE^MAGDIR3	GE Medical Systems, HiSpeed CT/i, CT
GECTHISA^MAGDIR3	GE Medical Systems, HiSpeed RP, CT
LONGCASE^MAGDIR3	GE Medical Systems, ProSpeed, CT
LONGCASE^MAGDIR3	GE Medical Systems, Rhapsode, CT
LONGCASE^MAGDIR3	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
LONGCASE^MAGDIR3	Lumisys, LS75, CR, CT, MR, MRI, NM, OT, RAD, SC and US
PQ2000^MAGDIR3	Picker International, Inc., AX000, MR
PQ2000^MAGDIR3	Picker International, Inc., Edge 1.5T, MR
PQ2000^MAGDIR3	Picker International, Inc., Polaris, CT
PQ2000^MAGDIR3	Picker International, Inc., PQ2000, CT

Parameter Value	Equipment
PQ2000^MAGDIR3	Picker International, Inc., PQ2000, SC
LONGCASE^MAGDIR3	Picker International, Inc., PQ5000, CT
PQ2000^MAGDIR3	Picker International, Inc., PQ5000, CT
LONGCASE^MAGDIR3	Picker International, Inc., PQ5000, SC
PQ2000^MAGDIR3	Picker International, Inc., PQ5000, SC
PQ2000^MAGDIR3	Picker International, Inc., PQ6000, CT
PQ2000^MAGDIR3	Picker International, Inc., PQS, CT
PQ2000^MAGDIR3	Picker International, Inc., PQS, SC
PQ2000^MAGDIR3	Picker International, Inc., VOXEL, CT
PQ2000^MAGDIR3	Picker International, Inc., VOXELQ, CT
IGNORE^MADGIR3	(skip this image)

Note: There are multiple possibilities for the same modality, depending upon whether the image was sent directly or via a commercial PACS.

B.4.2.2.3 Text Data Subroutines - Setup

Possible names of subroutines that generate extra text data are:

Line Tag^Name	Description
GECT^MAGDIR4A	General Electric CTs
PICKERCT^MAGDIR4A	Picker CTs
PHILIPCT^MAGDIR4A	Philips CTs
GELCA^MAGDIR4A	General Electric LCA DLX

B.4.2.2.3.1 Typical Values for Data Extraction Subroutine

Parameter Value	Equipment
(none)	Accuson, Sequoia, US
(none)	ADAC, *, NM
(none)	ADAC, Solus, NM
(none)	ADAC, Vertex, NM
(none)	AGFA, ADC 5145, CR
(none)	Aspect Electronics, Inc., Access Acquisition Module, US and OT
(none)	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US
(none)	DeJarnette Research Systems, ImageShare CR, CR
(none)	DeJarnette Research Systems, Imageshare Fuji CR Acquisition Station, CR
(none)	Diasonics, *, US
GELCA^MAGDIR4A	GE Medical Systems, DLX, XA and RF
GECT^MAGDIR4A	GE Medical Systems, Genesis CT9800 QHL, CT
GECT^MAGDIR4A	GE Medical Systems, Genesis HiSpeed RP, CT
GECT^MAGDIR4A	GE Medical Systems, Genesis Jupiter, CT
GECT^MAGDIR4A	GE Medical Systems, Genesis Signa, MR
GECT^MAGDIR4A	GE Medical Systems, HiSpeed CT/i, CT
GECT^MAGDIR4A	GE Medical Systems, HiSpeed RP, CT
GECT1000^MAGDIR4A	GE Medical Systems, ProSpeed, CT
GECT^MAGDIR4A	GE Medical Systems, Rhapsode, CT
(none)	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
(none)	Lumisys, LS75, CR, CT, MR, MRI, NM, OT, RAD, SC and US

Parameter Value	Equipment
(none)	Picker International, Inc., AX000, MR
(none)	Picker International, Inc., Edge 1.5T, MR
PickerCT^MAGDIR4A	Picker International, Inc., Polaris, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQ2000, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQ2000, SC
PickerCT^MAGDIR4A	Picker International, Inc., PQ5000, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQ5000, SC
PickerCT^MAGDIR4A	Picker International, Inc., PQ6000, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQS, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQS, SC
PickerCT^MAGDIR4A	Picker International, Inc., VOXEL, CT
PickerCT^MAGDIR4A	Picker International, Inc., VOXELQ, CT

B.4.2.2.4 Text Data File - Setup

Possible names of files with DICOM elements to be output as text data are:

Name	Description
DataGECT.dic	General Electric CTs
Data_CR.dic	CR Units
DataMisc.dic	Miscellaneous
Data_MRI.dic	MRI Units

B.4.2.2.4.1 Typical Values for Text Data Extraction Element List

Parameter Value	Equipment
datamisc.dic	Accuson, Sequoia, US
datamisc.dic	ADAC, *, NM
datamisc.dic	ADAC, Solus, NM
datamisc.dic	ADAC, Vertex, NM
datamisc.dic	AGFA, ADC 5145, CR
datamisc.dic	Aspect Electronics, Inc., Access Acquisition Module, US and OT
datamisc.dic	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US
datamisc.dic	DeJarnette Research Systems, ImageShare CR, CR
datamisc.dic	DeJarnette Research Systems, Imageshare Fuji CR Acquisition Station, CR
datamisc.dic	Diasonics, *, US
datamisc.dic	GE Medical Systems, DLX, XA and RF
datagect.dic	GE Medical Systems, Genesis CT9800 QHL, CT
datagect.dic	GE Medical Systems, Genesis HiSpeed RP, CT

Parameter Value	Equipment
datagect.dic	GE Medical Systems, Genesis Jupiter, CT
datagect.dic	GE Medical Systems, Genesis Signa, MR
datagect.dic	GE Medical Systems, HiSpeed CT/i, CT
datagect.dic	GE Medical Systems, HiSpeed RP, CT
datagect.dic	GE Medical Systems, ProSpeed, CT
datagect.dic	GE Medical Systems, Rhapsode, CT
datamisc.dic	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
datamisc.dic	Lumisys, LS75, CR, CT, MR, MRI. NM, OT, RAD, SC and US
datamisc.dic	Picker International, Inc., AX000, MR
datamisc.dic	Picker International, Inc., Edge 1.5T, MR
datagect.dic	Picker International, Inc., Polaris, CT
datagect.dic	Picker International, Inc., PQ2000, CT
datagect.dic	Picker International, Inc., PQ2000, SC
datagect.dic	Picker International, Inc., PQ5000, CT
datagect.dic	Picker International, Inc., PQ5000, SC
datagect.dic	Picker International, Inc., PQ6000, CT
datagect.dic	Picker International, Inc., PQS, CT
datagect.dic	Picker International, Inc., PQS, SC
datagect.dic	Picker International, Inc., VOXEL, CT
datagect.dic	Picker International, Inc., VOXELQ, CT

B.4.2.3 Example of a MODALITY.DIC File

An example of a portion of a MODALITY.DIC file is show below:

```
GE MEDICAL SYSTEMS|DLX|XA|b10

…|STUDYID^MAGDIR3|GELCA^MAGDIR4A|datamisc.dic

Picker International, Inc.|PQ2000|CT|b12 a1000 f0 c4095
…|PQ2000^MAGDIR3|PICKERCT^MAGDIR4A|datagect.dic

Picker International, Inc.|PQ2000|SC|b12 a1000 f0 c4095
…|PQ2000^MAGDIR3|PICKERCT^MAGDIR4A|datagect.dic

DeJarnette Research Systems|Imageshare Fuji CR Acquisition Station|CR|
…|b10 f0 c1023 R8/b10 f0 c1023|LONGCASE^MAGDIR3||datamisc.dic

LUMISYS|*|CR|b12 f0 c4095 R8|LONGCASE^MAGDIR3||datamisc.dic
```

Note 1: There are two entries for the Picker CT. Each image from the unit is processed as an individual file. The first entry in the file **F:\DICOM\Dict\Modality.DIC** is for processing the CT images themselves. The second entry is for the processing of the reference or scout image, which is identified as being a secondary capture (SC) modality image.

Note 2: The Fuji CR has two sets of image processing rules, the first for the reference quality image (reduce 8:1 by combining four 10-bit pixels into one 8-bit pixel), and the second for the full-resolution diagnostic quality image.

Note 3: The headers of the files produced by the LUMISYS film scanner do not contain a model field.

A sample file **F:\DICOM\Dict\Modality.Sample** is supplied with the **V*IST*A** Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\Modality.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be transferred to the operational master file at the discretion of the site.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.582,d0,0) = Manufacturer ^ Model ^ Modality

                        ^ DCMTOTGA [ / DCMTOTGA ] ^ Accession Number Subroutine

                                    ^ Text Data Subroutine ^ Text Data Filename

^MAGDICOM(2006.582,"B",Manufacturer,Model,Modality,d0) = ""
```

B.4.3 Portlist.DIC

The file **F:\DICOM\Dict\PortList.DIC** contains the port numbers of commercial PACS (typically Mitra Brokers) that receive messages from the DICOM Text Gateway. This file is

read by routine **^MAGDMB8** to (re)construct the FileMan table **Radiology TCP/IP Provider Port** (File 2006.584, stored in **^MAGDICOM(2006.584,…)**). This should be done manually as part of the installation process, and whenever operational information has changed at the site.

Use the **V*IST*A** Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance

→ 2. Gateway Configuration and DICOM Master Files

→ → 4. Update PortList.DIC

The **V*IST*A** DICOM Text Gateway has the ability to send (push) data to multiple destinations. These destinations may be commercial PACSs or commercial providers of the DICOM Modality Worklist service. The file **F:\DICOM\Dict\PortList.DIC** is used to specify the communication ports for each of the different applications receiving **V*IST*A** text transactions.

- Portlist Record: <menu-option> | <AE title> | <port number> | <file mode> | <channel>

The various fields are defined below:

<menu-option> The text for the communications menu of the **V*IST*A** DICOM Text Gateway.

<AE title> The application entity title of the service.

<port number> The the network communications port number.

<file mode> Specifies that the service will use fifo queue file buffering.

<channel> Is 1:n, for the DICOM\DATA1 to DICOM\DATAn directory.

An example of the file **F:\DICOM\Dict\PortList.DIC** is shown below:

```
#Menu-option|AE Title|Port|File Mode (FIFO QUEUE or DIRECT)|CHANNEL
PACS Interface|VistA PACS I/F|60041|FIFO QUEUE|1
#MITRA Broker Interface|VistA PACS I/F|60042|FIFO QUEUE|2
#DeJarnette Medishare Interface|VistA PACS I/F|60043|FIFO QUEUE|2
```

A sample file **F:\DICOM\Dict\PortList.Sample** is supplied with the **V*IST*A** Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\PortList.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be transferred to the operational master file at the discretion of the site.

The port number for this dictionary should be on the range 60040:60049 – see Appendix E.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.584,d0,0) = Destination ^ Name ^ Port ^ Mode ^ Channel

^MAGDICOM(2006.584,"B",Destination,d0) = ""
```

B.4.4 SCU_List.DIC

The file **F:\DICOM\Dict\SCU_List.DIC** contains the definitions of the various DICOM User Applications that are being used at the site. This file is read by routine **^MAGDMB9** and to (re)construct the FileMan table **User Application** (File 2006.585, stored in **^MAGDICOM(2006.585,…)**). This should be done as part of the installation process, and whenever operational information has changed at the site.

Use the **V*IST*A** Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance

→ 2. Gateway Configuration and DICOM Master Files

→ → 5. Update SCU_List.DIC

The file **F:\DICOM\Dict\SCU_List.DIC** defines the DICOM applications that **V*IST*A** can invoke as a **S**ervice **C**lass **U**ser (SCU). All the information needed by **V*IST*A** to initiate the association is included in this file.

There are three kinds of records in the file **F:\DICOM\Dict\SCU_List.DIC**. The first is the "provider" record, which identifies the service class provider (SCP) of the DICOM application. Following the provider record are one or more "service" records defining the services to be utilized. "Service" records may be followed by "transfer syntax" records.

- Provider Record: <application name> | <called AE title> | <calling AE title> | <destination IP address> | <destination port number>
- Service Record: <presentation context name> | <transfer syntax name>
- Transfer Syntax Record: | | <transfer syntax name>

The different fields are defined below:

<application name>	The name that **V*IST*A** uses to refer to the DICOM application.
<called AE title>	The title of the called provider (SCP) application entity.
<calling AE title>	The name of the **V*IST*A** user (SCU) application entity.
<destination IP address>	The network IP address of the provider (SCP) application entity.

<destination port number> The network port number for the provider (SCP application entity.

<presentation context name> The name of the DICOM service object pair (SOP).

<transfer syntax name> The name of the DICOM transfer syntax

Editing the file **F:\DICOM\Dict\SCU_List.DIC** implies changing the <destination IP address> and <destination port number> fields in the provider record. These values come from the commercial equipment providers.

The following is an example of entries in the file **F:\DICOM\Dict\SCU_List.DIC**:

```
# User Application List
# Format:
# line 1:App Name|Called AE|Calling AE|Destination IP Address|Socket
# line 2:|Presentation Context Name|Transfer Syntax Name
# line 3:||Transfer Syntax Name (if there are more than one)
#
EMED Query/Retrieve|EMED_SCP_LAND|VA VISTA|111.222.33.44|104
|Verification SOP Class|Implicit VR Little Endian
|Study Root Query/Retrieve Information Model - MOVE|Implicit VR Little
Endian
#
```

A sample file **F:\DICOM\Dict\SCU_List.Sample** is supplied with the **V*IST*A** Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\SCU_List.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be transferred to the operational master file at the discretion of the site.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.585,d0,0) = Service name

^MAGDICOM(2006.585,d0,1,d1,0) = SOP Class

^MAGDICOM(2006.585,d0,1,d1,1,d2,0) = Transfer Syntax

^MAGDICOM(2006.585,"B",Service name,d0) = ""

^MAGDICOM(2006.585,d0,1,"B",SOP Class,d1) = ""

^MAGDICOM(2006.585,d0,1,d1,1,"B",Transfer Syntax,d2) = ""
```

B.4.5 Worklist.DIC

The file **F:\DICOM\Dict\WorkList.DIC** contains the definitions of the various parameters that are needed for Modality Worklist processing by the instruments that are being used at the site. This file is read by routine **MAGDMB8** and to (re)construct the FileMan table **Radiology Worklist Dictionary** (File 2006.583, stored in **^MAGDICOM(2006.583,…)**). This is done manually as part of the installation process, and whenever operational information has changed at the site.

After editing, use the **V*IST*A** Imaging DICOM Gateway menu option to update this master file as follows:

4. System Maintenance

→ 2. Gateway Configuration and DICOM Master Files

→ → 6. Update WorkList.DIC

The file **F:\DICOM\Dict\WorkList.DIC** is used in conjunction with the **V*IST*A** Modality Worklist Service Class Provider. It maps the modality issuing the request to the corresponding site of image acquisition, image service, and image type. The record defining the modality is defined below:

<calling AE Title> | <location name> | <imaging service> | <imaging type> | <accession number flag>

The different fields are defined below:

<calling AE Title>	The AE title of the modality; different units should use different AE titles.
<location name>	The name of the institution (as defined in `$Piece(^DIC(4,number,0),"^",1)`.).
<imaging service>	The name of the imaging service (as defined in FileMan File 2006.589, **Imaging Service Dictionary**, stored in `^MAGDICOM(2006.589,…)`).
<imaging type>	The abbreviation for the Imaging Type (as defined in FileMan File 79.2, **Imaging Type**, stored in `^RA(79.2,…)`).
<accession number flag>	Specifies whether short or long format is used for the case number.
<description>	A description that describes the equipment and typically also its location.

An example of the WORKLIST.DIC file is shown below:

```
#Station AE Title|Location Code|Imaging Service|Imaging Type|Short or
Long Accession Number
SCANNER1|Baltimore, MD|RAD|RAD|LONG|North Clinic
PICKER_CT_TONY|Baltimore, MD|RAD|RAD|LONG|Second Floor, Room E16a
```

The file WORKLIST.DIC has to be edited for every new instrument using the **V*IST*A** modality worklist service.

- Names of locations must be spelled as in the **Institution** File (File number 4, stored in `^DIC(4,...)`). These names are processed in a case-insensitive fashion. Only the part of the name before the first comma needs to match the value in the institution file. Any other punctuation characters that occur in that part of the "official" name must appear in the value that is entered here.

  If no name is specified for the name of a location, the default value from the Kernel Site Parameter in **^DD("SITE",1)** will be used.

- Names of imaging services must be spelled as in the **Imaging Service** File (File number 2006.589, stored in `^MAGDICOM(2006.589,…)`. These names must be spelled in all upper-case characters. Currently, only "**RAD**" and "**MED-ENDO**" (for GI fluoroscopy only) are supported.

- Names of imaging types must be spelled as in the **Imaging Type** File (File number 79.2, stored in `^RA(79.2,…)`. These names must be spelled in all upper-case characters. Currently supported are: "**ANI**" (Angio, Neuro or Interventional), "**CARD**" (Cardiology studies, Nuclear Medicine), "**CT**" (Computerized Tomography Scan), "**MAM**" (Mammography), "**MRI**" (Magnetic Resonance Imaging), "**NM**" (Nuclear Medicine), "**RAD**" (General Radiology), "**US**" (Ultrasound) and "**VAS**" (Vascular Laboratory).

A sample file **F:\DICOM\Dict\WorkList.Sample** is supplied with the **V*IST*A** Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\WorkList.DIC**. When performing an upgrade, the existing copy of the file will remain unaffected. Information from the sample file may be transferred to the operational master file at the discretion of the site.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.583,d0,0) = AE Title ^ Site ^ Service ^ Type ^ Accession

^MAGDICOM(2006.583,"B",AE Title,d0) = ""
```

Appendix C Networking Fundamentals

C.1 Overview

TCP/IP interprocess (i.e., computer-to-computer) communications are performed between operating system endpoints called sockets. A socket is assigned a unique numeric port value (1-65535) when it is placed into use. Server applications allocate sockets and assign well-known port numbers when they start up. Client applications allocate sockets and access the server applications via the well-known port numbers.

Internet convention reserves port numbers 1-1023 for the system. The telnet server application, for example, uses port number 23. Port numbers 1024-5000 are automatically assigned by the system, as needed, for things like handling telnet client sessions. Port numbers above 5000 are available for user-developed services[2] (e.g., VA Kernel Broker uses 9200).

DICOM applications require well-known port numbers. The port numbers for the **V*IST*A** Imaging DICOM Gateway are assigned in a consistent dedicated fashion so that each application always uses the same port number, and different applications are always assigned different port numbers. This allows applications to be moved between machines for redundancy and load balancing, without requiring the port numbers to be reconfigured. The **V*IST*A** Imaging DICOM Gateway applications use port numbers in the range of 60000-61000 (see Appendix A).

C.2 IP Addresses and Subnet Masks

Internet Protocol (IP) addresses are defined for network interfaces. More than one address may be defined for an individual network interface, and a machine may have more than one network interface. If a machine has more than one network interface, the IP address for each of the interfaces must be assigned in different subnets.

IP addresses are 32 bits long and are represented in the format *aaa.bbb.ccc.ddd*, where *aaa*, *bbb*, *ccc*, and *ddd* are the first, second, third, and fourth octets (bytes) respectively.

Large organizations sub-divide their network namespace into logically independent *subnets*.

With the TCP/IP protocol suite, two machines can directly communicate with one another *only if they have IP addresses that are in the same subnet*. Otherwise, routers must be used to provide inter-subnet store and forward communications.

The *subnet mask* is used to patition the network namespace IP addresses into the different subnets.

---

[2] UNIX® Network Programming, W. Richard Stephens, Prentice Hall, 1990, page 304.

The subnet mask is also 32 bits long and has the same *aaa.bbb.ccc.ddd* format as the IP address. By definition, the subnet mask consists of a string of high-order ONE bits followed by a string of low-order ZERO bits. The bits in the *aaa* octet of the subnet mask are usually set to ONE. The *bbb, ccc,* and *ddd* octets have a specific number of high-order ONE bits and low-order ZERO bits. The sequence of the ONE bits in the subnet mask define the subnet of the IP address. In a very frequently used combination in the VA, the *ccc* and *ddd* octets may have a string of nine high-order ONE bits followed by seven low-order ZERO bits. The resulting decimal sequence 255.255.255.128 (i.e., 11111111.11111111.11111111.10000000 in binary) is commonly referred to as a nine-bit subnet mask.

The selection of the subnet mask is a crucial configuration factor governing performance in the imaging network.

Two IP addresses are in the same subnet if two conditions are meet:

- They have the same subnet mask.
- The logical AND of the subnet mask and each IP address are the same.

Routing imposes a network bottleneck for high-volume LAN applications like imaging. It is highly desirable, for performance reasons, to avoid routing imaging traffic, whenever possible. One way to accomplish this is to use a switched network topology and place all of the components (workstations, servers, etc.) in the same subnet. Another way is to have separate subnets, but to assign multiple IP addresses to the servers, one for each subnet.

C.2.1 Example 1 – Original Configuration – Nine-bit Subnet Mask

Assume that machines A, B, C, and D are all on the same switched network. Machines A and B are NT file servers containing images, and machines C and D are imaging workstations.

Subnet Mask	255.255.255.128	(nine-bit subnet mask)
IP Address A	111.222.34.30	
IP Address B	111.222.34.31	
IP Address C	111.222.34.130	
IP Address D	111.222.34.131	

Note: In all the examples in this document, dummy IP addresses starting with 111.222 are used. (Please ignore the fact that 111.xxx.yyy.zzz is a Class A network address, while 152.xxx.yyy.zzz is a Class B one.)

The subnet mask specifies that the upper three octets and the high order bit of the low order octet must be the same. The seven low order bits may be different.

There are 128 (2^7) different IP address combinations in this subnet, of which 126 may be used. (The lowest and highest address in the range are reserved.)

In Example 1, there are two different subnets: 111.222.34.0 to 111.222.34.127 and 111.222.34.128 to 111.222.34.255. IP Addresses A and B are in one subnet (see Figure 10.1), while IP addresses C and D are in another subnet (see Figure 10.2).

IP Address "A" Logically ANDed with Subnet Mask

	Decimal Notation	Binary Notation
IP Address "A"	111.222.34.30	01101111.11011110.00100010.00011110
Subnet Mask	255.255.255.128	11111111.11111111.11111111.10000000
Logical AND	111.222.34.0	01101111.11011110.00100010.00000000

Figure 10.1

IP Address "C" Logically ANDed with Subnet Mask

	Decimal Notation	Binary Notation
IP Address "C"	111.222.34.130	01101111.11011110.00100010.10000010
Subnet Mask	255.255.255.128	11111111.11111111.11111111.10000000
Logical AND	111.222.34.128	01101111.11011110.00100010.10000000

Figure 10.2

Machines A and B can communicate directly with each other, as can machines C and D, but machines A and B can not directly communicate with machines C and D. A router is required in order for machines A & B to communicate with machines C & D.

Rather poor image retrieval performance is obtained in the Example 1 configuration because every byte of data transferred from the file servers (A & B) to the workstations (C & D) must pass through

the router. As Example 2 will show, merely by changing the subnet mask by one bit can dramatically improve image transfer times.

C.2.2 Example 2 – Change to Eight-bit Subnet Mask

Assume that machines A, B, C, and D are all on the same switched network. Machines A and B are NT file servers containing images, and machines C and D are imaging workstations.

Subnet Mask	255.255.255.0	(eight-bit subnet mask)
IP Address A	111.222.34.30	
IP Address B	111.222.34.31	
IP Address C	111.222.34.130	
IP Address D	111.222.34.131	

In Example 2, there is only one subnet: 111.222.34.0 to 111.222.34.255 with 254 usable IP addresses. Machines A , B, C, and D can directly communicate with each other without requiring a router.

There is a significant gain in performance for the imaging application between the first and the second configuration. The second configuration is much faster than the first because the images can be retrieved from the file servers directly, without having to be passed through a router.

C.2.3 Example 3 – Keep Nine-bit Subnet Mask and Add Secondary IP Address to Servers

Another option is to keep the original nine-bit subnet masks and add secondary IP addresses to the servers.

Assume that machines A, B, C, and D are all on the same switched network. Machines A and B are NT file servers containing images, and machines C and D are imaging workstations.

Subnet Mask	255.255.255.128	(nine-bit subnet mask)
IP Address A	111.222.34.30, 111.222.34.250	
IP Address B	111.222.34.31, 111.222.34.251	
IP Address C	111.222.34.130	
IP Address D	111.222.34.131	

In Example 3, there are the two original subnets: 111.222.34.0 to 111.222.34.127 and 111.222.34.128 to 111.222.34.255. IP Addresses C and D are in one subnet, but IP addresses A and B are in both subnets. Machines A , B, C, and D can directly communicate with each other without

requiring a router. Like Example 2, there is a similar significant gain in performance for the imaging application with this configuration.

For several years, the nine-bit subnet mask 255.255.255.128 was the recommended for the VA when the network topology consisted of several subnets connected by routers. With the new switched network topology consisting (ideally) of a single subnet containing several segments connected together by switches, other subnet mask values will be used.

The Telecommunications Support Office recommends using Variable Length Subnet Masks with a switched network topology in order to minimize the router load and maximize throughput. This means using different size subnet masks for different parts of the network IP address space.

In order to achieve optimal performance in a switched network topology, partition the IP address space and assign subnet masks to provide the largest possible subnets and minimize routing.

C.2.4 Example 4 – Use Multiple Subnets

A VAMC has been assigned the 111.222.29.1 to 111.222.32.126 range of IP addresses. All addresses outside this range are assigned to other facilities. The entire VAMC is wired with a 100 Base TX switched network infrastructure. What subnet masks should be used to provide the largest possible subnets?

The best solution is to use three subnets as follows:

Name	IP Address Range	Subnet Mask	Number of Addresses
Subnet A	111.222.29.1 - 111.222.29.254	255.255.255.0 eight-bit subnet mask	254
Subnet B	111.222.30.1 - 111.222.31.254	255.255.254.0 seven-bit subnet mask	510
Subnet C	111.222.32.1 - 111.222.32.126	255.255.255.128 nine-bit subnet mask	126

Note how the values of the IP addresses affect the way that the subnets can be constructed. The high-order bits of the IP address ANDed with the subnet mask must be the same for the entire subnet. IP addresses 111.222.30.* and 111.222.31.* can be placed into the same subnet using the seven-bit mask because the value of the ANDs are both 111.222.30.0. Note, however, that IP addresses

111.222.29.* and 111.222.30.* cannot be placed into the same subnet using the seven-bit mask, because the value for the ANDs are different, 111.222.28.0 and 111.222.30.0 respectively.

Subnet A can accommodate the imaging application with up to 250 workstations with no need for routing. An application with more workstations (like office automation) might be placed in Subnet B. Miscellaneous applications can be placed in Subnet C.

If the nine-bit subnet mask were used instead of the variable length subnet mask scheme, there would be seven subnets with 126 addresses in each. The image file servers could then have multiple IP addresses, one in each subnet to avoid much of the routing. Otherwise considerably more routing would be required.

Another site has used subnet mask 255.255.128.0 (allowing 32,766 addresses) so that all the devices in the facility are on the same subnet. It is also possible to use a VISN-wide Class A private network address scheme with a subnet mask 255.0.0.0 and IP addresses like 10.130.xxx.yyy. (The site then may need to provide an IP address conversion capability so that Silver Spring can access the gateway using pcAnywhere.)

Warning -- changes to the subnets need to be reflected in the routers and the other systems on the network.

For further information, contact your CIO Network Group and the network vendor specialists.

C.3 Default Gateways

A Default Gateway is typically a port on a router that is used to transfer traffic between subnets. The default gateway port IP address must be in the same subnet as the IP address of the network interface. Typically, the bottom or top address in a subnet is used as the IP address for the default gateway. In this example, the default gateway IP address might be 111.222.34.1 or 111.222.34.126 for IP addresses A and B, and 111.222.34.129 or 111.222.34.254 for IP addresses C and D.

It is possible to set the default gateway IP address incorrectly and still get routing to occur. Some routers have an “automatic address resolution option”, which, if enabled, will automatically resolve IP addresses and perform routing, in spite of the fact that the default gateway IP address may be incorrect. This “feature” may tend to “hide” IP address problems and may promote bad networking practices.

The IP addresses on a Windows workstation are set by mouse clicking on Start, picking Settings, and selecting Control Panel. Clicking on the Network icon on the Control Panel window brings up the Network window. Selecting the Protocols tab brings up a list of the installed network protocols. Selecting the TCP/IP Protocol and the Properties button brings up the Microsoft TCP/IP Properties window. Select the adapter and enter the IP address, subnet mask, and default gateway. The system may have to be rebooted afterwards.

The Advanced button brings up the Advanced IP Addressing window which allows the entry of the additional IP addresses. The IP addresses can been in either the same subnet or in different subnets.

This is very useful for connecting servers to multiple subnets. It is also useful in the event of a system failure for redirecting communications to an operational **V*IST*A** DICOM machine.

For imaging workstations, the IP address, subnet mask, default gateway, and other parameters, such as WINS and DNS addresses, can be left blank and be assigned at run time using the Dynamic Host Configuration Protocol (DHCP). This should not be used for **V*IST*A** Imaging DICOM Gateways, however, as permanent (i.e., "hard coded") IP addresses are usually required for communications by the commercial DICOM equipment.

C.4 HOSTS File

The HOSTS file maps IP addresses to aliases. Aliases are mnemonics, memory aids that can serve multiple purposes. It is very useful to place entries for all the commercial DICOM equipment into the HOSTS file of the **V*IST*A** Imaging DICOM Gateway.

Using aliases makes it much easier to access the other systems. The aliases can be used in commands in place of the numeric IP addresses. If it is necessary to change the IP address of the commercial DICOM equipment, it can be changed in the HOSTS file while keeping the same familiar alias.

Service providers can use the information in the HOSTS file in a reverse fashion, to lookup incoming client IP addresses and display the corresponding alias.

Example of HOSTS file:

```
# VAMC DICOM Image Producing Modalities

111.222.35.30 CT1              # Picker CT PQ-2000 #1

111.222.35.31 CT2              # Picker CT PQ-2000 #2

111.222.35.32 CT3              # GEMS High Speed Advantax CT
```

The HOSTS file is not limited to IP addresses of other systems, however. Aliases can also point to the current system (using the IP address 127.0.0.1) and form a local loopback.

The **V*IST*A** DICOM application makes use of this capability by defining aliases to identify different telnet processes running on the current system. The telnet windows for the different processes are started with the different aliases. Each telnet window displays the alias in its title bar while it is running, identifying the process (The alias can also contain the menu prompt numbers, making it easier to start the process).

Example of HOSTS file:

```
# local host telnet connections for the VistA DICOM PACS Interface
# VistA DICOM Text Gateway
127.0.0.1   TEXT_INTERFACE_1_1       # HIS to DICOM Test Interface
127.0.0.1    EMED_PACS_1_2_1         # EMED PACS Communications
127.0.0.1    MITRA_BROKER_1_2_2      # MITRA / FUJI Communications
```

The command "telnet EMED_PACS_1_2_1" will display "Telnet – EMED_PACS_1_2_1" in the title bar at the top of the window.

Appendix D Diagnostic Networking Tools

D.1 HOSTDIR.BAT

The full path to the HOSTS file is several directories deep and is system dependent (e.g., `c:\WINNT\system32\drivers\etc\hosts`). Rather than trying to remember which path to use for which system and typing in the whole thing every time, use the following script:

```
cd %SystemRoot%\system32\drivers\etc
```

This takes you to the directory containing the HOSTS file. The script is stored in the file **`c:\Program Files\VistA\Imaging\DICOM\hostdir.bat`.** The installation procedure ensures that this directory will be included in the "path", so that this command file can be started by simply typing "`hostdir`".

D.2 IPCONFIG

The current system's IP address, subnet masks, and default gateways can be conveniently displayed with the IPCONFIG command, as shown below.

```
c:\>ipconfig

Windows NT IP Configuration

Ethernet adapter DC21X42:

    IP Address. . . . . . . . . . : 222.111.36.138
    Subnet Mask . . . . . . . . . : 255.255.255.192
    Default Gateway . . . . . . . : 222.111.36.190

Ethernet adapter DC21X41:

    IP Address. . . . . . . . . . : 111.222.36.39
    Subnet Mask . . . . . . . . . : 255.255.255.128
    IP Address. . . . . . . . . . : 111.222.36.40
    Subnet Mask . . . . . . . . . : 255.255.255.128
    Default Gateway . . . . . . . : 111.222.36.122
```

Note that the second network interface has two different IP addresses assigned to it. This illustrates how one **V*IST*A** Imaging DICOM Gateway can be configured to subsume the tasks of another, in the event of a system failure. In this example, the system with IP address 111.222.36.40 was taken out of service and all of its tasks were given to the system with IP address 111.222.36.39. The DICOM applications that had run on the old system now run on the new system without any changes to the commercial DICOM system's configuration files.

Multiple IP addresses can also be used in a switched network to span multiple subnets. These additional IP address can be defined by selecting the Advanced button of the Microsoft TCP/IP Properties window (see Section 2.3 above).

D.3 PING

Probably the most useful command for network troubleshooting is PING which, like the navy destroyers of old, listens for an echo response from its target destination. The pinging of Forum, the VA email system, is shown below:

```
c:\>ping forum

Pinging FORUM [111.222.38.25] with 32 bytes of data:

Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
```

or

```
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

The above example shows the results of a successful and an unsuccessful PING. The PING protocol uses "impc" request and response packets. Four "impc requests" were issued by PING and four (or zero) "impc responses" were received.

A system should always be able to ping its default gateway. A good initial test for physical network integrity is to try to ping the system's default gateway.

Note: While most DICOM devices support PING in both directions, at least one commercial DICOM image acquisition device (the GE Digital Radiofluoro DRS 3.1) simulates a phony PING function by attempting to establish an FTP session with the destination system. This does not work with the **V*IST*A** DICOM system, since Windows NT workstation does not normally provide an FTP server.

D.4 TRACERT

In addition to PING, Windows NT 4.0 supports TRACERT (trace route) to explicitly display the full route that is used to communicate with the target system. Much more diagnostic detail is presented with this tool. The route to Forum is shown below:

```
c:\>tracert forum

Tracing route to FORUM [111.222.38.25]
over a maximum of 30 hops:

  1   <10 ms   <10 ms   <10 ms  111.222.38.122
  2   <10 ms   <10 ms   <10 ms  FORUM [111.222.38.25]

Trace complete.
```

In the above example, the host system 111.222.38.39 used its default gateway 111.222.38.122 to hop first to the gateway 111.222.38.122 and then to FORUM 111.222.38.25.

D.5 NETSTAT

NETSTAT displays protocol statistics and current TCP/IP network connections. The telnet, NetBIOS, and DICOM sessions are displayed by NETSTAT, as shown in the following example:

```
C:\>netstat

Active Connections

  Proto  Local Address      Foreign Address        State
  TCP    isw-xxx:60000      localhost:1091         ESTABLISHED
  TCP    isw-xxx:60120      localhost:1096         ESTABLISHED
  TCP    isw-xxx:1091       localhost:60000        ESTABLISHED
  TCP    isw-xxx:1095       localhost:telnet       TIME_WAIT
  TCP    isw-xxx:1096       localhost:60120        ESTABLISHED
  TCP    isw-xxx:1070       VHAISWXX2:nbsession    ESTABLISHED
  TCP    isw-xxx:1073       VHAISWXX1:nbsession    ESTABLISHED
```

In this example, ports 1070 and 1073 are used for NetBIOS sessions, port 1095 is used for a telnet client (to the telnet server port 23), and the other ports were used for DICOM. Port 60000 and 60120 were used for the **V*IST*A** DICOM application, while ports 1091 and 1096 were assigned by the system for DICOM clients.

D.6 DICOM_Echo

Note: The DICOM_Echo utility is part of our normal distribution, and is located in the **c:\Program Files\VistA\Imaging\DICOM** directory.

C-ECHO is a DICOM service that is used to verify communications to a remote DICOM application entity (AE). A Verification SOP Class user can send a C-ECHO request to another DICOM AE. If the remote AE is a Verification SOP Class provider, it will return a C-ECHO response back to the original requesting AE. This function is analogous to a DICOM application-level PING.

DICOM_Echo is a public domain utility written by the Mallinckrodt Institute of Radiology that sends a C-ECHO request to a remote DICOM AE, and then waits for a response.

To View HELP:

```
C:\User>dicom_echo
dicom_echo [-a title] [-d] [-c title] [-m mode] [-n num] [-p] [-r repeat] [-s
sleeptime] [-v] [-x] node port
```

```
    a     Application title of this application
    c     Called AP title to use during Association setup
    d     Drop Association after echo requests
    m     Mode for SCU/SCP negotiation (SCU, SCP, SCUSCP)
    n     Number of network connections
    p     Dump service parameters after Association Request
    r     Number of times to repeat echo request
    s     Time to sleep after each echo request
    v     Verbose mode for DUL/SRV facilities
    x     Do not release Associations when finished with echo

    node  Node name of server
    port  Port number of server
```

Actual Usage:

```
C:\User>dicom_echo 111.222.36.38 60120
Echo context: Context
Verification Response
  Message ID Responded to:    1
  Verification Status:     0000
Echo Response
Message ID Responded To: 1
Data Set Type:           0101
Status:                  0000  Status Information:-
        Successful operation
Class UID:               1.2.840.10008.1.1
```

D.7 Send_Image

Note: The Send_Image utility is part of our normal distribution, and is located in the **c:\Program Files\VistA\Imaging\DICOM** directory.

C-STORE is the DICOM service that is used to transfer an image (i.e., a composite object) to a remote DICOM application entity. A Storage SOP Class user can send a C-STORE request to another DICOM AE. If the remote AE is a corresponding Storage SOP Class provider, it will accept the association and await image transfer. The Storage SOP Class user can then transfer one or more images to the Storage SOP Class provider. After the images are sent, it closes the association.

Send_Image is a public domain utility written by the Mallinckrodt Institute of Radiology to issue a C-STORE request and send one or more images to a remote DICOM Storage SOP Class provider.

To View HELP:

```
C:\User>send_image
send_image [-a application] [-c called] [-m maxPDU] [-p] [-q] [-r] [-s
SOPName][-t] [-x FAC] [-v] node port image [image...]

    -a    Set application title of this (calling) application
    -c    Set called AE title to title in Association RQ
    -m    Set maximum PDU in Association RQ to maxPDU
```

```
    -p    Alter image by sending minimal pixel data
    -q    Quiet mode.  Suppresses some messages to stdout
    -r    Make program sensitve to response status.  If not success, stop
    -s    Force an initial Association using one SOP Class based on SOPName
          (CR, CT, MR, NM, SC, US)
    -t    Time the image transfer.  Print elapsed time and transfer rate.
    -v    Place DUL and SRV facilities in verbose mode
    -x    Place one facility(DCM, DUL, SRV) in verbose mode

    node  Node name for network connection
    port  TCP / IP port number of server application
    image A list of one or more images to send
```

Actual Usage:

```
C:\User>send_image -q cemax30 104 a0000001.dcm a0000002.dcm a0000003.dcm
Store Response
Message ID Resp:1
Data Set Type:  0101
Status:         0000  Status Information:-
        Successful operation
Class UID:      1.2.840.10008.5.1.4.1.1.2
Instance UID:   1.2.840.113619.2.1.11101.786458237.2.11.858271581
Store Response
Message ID Resp:2
Data Set Type:  0101
Status:         0000  Status Information:-
        Successful operation
Class UID:      1.2.840.10008.5.1.4.1.1.2
Instance UID:   1.2.840.113619.2.1.11101.786458237.2.11.858271582
Store Response
Message ID Resp:3
Data Set Type:  0101
Status:         0000  Status Information:-
        Successful operation
Class UID:      1.2.840.10008.5.1.4.1.1.2
Instance UID:   1.2.840.113619.2.1.11101.786458237.2.11.858271583
```

Appendix E Port Numbers for V*IST*A Imaging DICOM Gateway Applications

Attention: For interprocess communications, DICOM applications require well-known port numbers[3].

The **V*IST*A** Imaging DICOM Gateway uses port numbers in the 60000-61000 range, in order to avoid conflicting with those used by other applications. (Note that 104 is commonly used as the default port number for DICOM.)

The following table contains suggested port numbers for the **V*IST*A** DICOM Applications.

V*IST*A Imaging DICOM Gateway Application	**Port Number**
Image acquisition MUMPS storage controller	60000
Modality Worklist SCP	60010
Performed Procedure Step SCP	60020
Storage Commitment SCP	60030
Commercial PACS Text Interface	60040
Commercial Modality Worklist SCP #1	60041
Commercial Modality Worklist SCP #2	60042
Query Retrieve SCP	60050
CR Modality – Image Storage	60100 – 60109
Digital Radiography – Image Storage	60110 – 60119
CT Modality – Image Storage	60120 – 60129

[3] DICOM applications require "hard coded" IP addresses and cannot use those assigned by the **D**ynamic **H**ost **C**onfiguration **P**rotocol (DHCP).

V*IST*A Imaging DICOM Gateway Application	**Port Number**
MR Modality – Image Storage	60130 – 60139
Digital Radio Fluoro – Image Storage	60140 – 60149
Digital Angiography – Image Storage	60150 – 60159
Ultrasound – Image Storage	60160 – 60169
Nuclear Medicine – Image Storage	60170 – 60179
Visible Light – Image Storage	60180 – 60189
Film Digitizer – Image Storage	60190 – 60199
Default – Image Storage	104

Appendix F VISTA Imaging DICOM Gateway Application Entity (AE) Titles

DICOM requires the calling application entity to supply both its AE title and the called AE title when the association request is made. The AE titles for the **VISTA** Gateway processes are listed in the following table. (These values are defined in the master file named `F:\DICOM\Dict\scp_list.dic`.)

VISTA Imaging DICOM Gateway Process	**Application Entity Title**
PACS Text Interface	VISTA_PACS_IF
Query/Retrieve Provider	VISTA_QR_SCP
Query/Retrieve User	VISTA_QR_SCU
Modality Worklist	VISTA_WORKLIST
Image Storage	VISTA_STORAGE